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SOME BYGONE OPERATIONS IN SURGERY.

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IV. AN HISTORICAL LITHOTOMY: MR. SAMUEL PEPYS.

IF Mr. Samuel Pepys had not been cut for stone on March 26, 1658, it is probable that his *Diary* would have been very different from that which we now read. He had been married for two years, and in the ordinary course of events would have led the domestic life of the period, and would have brought up a numerous progeny. The operation by injuring both his vasa deferentia left him sterile but not impotent, and throughout his *Diary* he shows himself to have been in a state of constant sexual excitement—desirous, but incapable of satisfying his lust with all the pretty but immodest women of his acquaintance.

Unfortunately from a medical point of view the lithotomy was performed two years before he began to write his *Diary*, which begins on Jan. 1, 1659–60, but the day was constantly in his mind, and the entry on March 26, 1660, is a faithful reflection of his thoughts at each return of spring. It runs :—

"This day it is two years since it pleased God that I was cut for stone at Mrs. Turner's in Salisbury Court. And did resolve while I live to keep it a festival, as I did the last year at my house and for ever to have Mrs. Turner and her company with me."

Two years later on March 26, 1662–3, the entry is :—

"Up early, this being by God's blessing the fourth solemn day of my cutting for the stone. At noon came my good guests. I had a pretty dinner for them, viz., a brace of stewed carps, six roasted chickens and a jowl of salmon hot for the first course; a tansy and two neats' tongues and cheese the second, and were very merry all the afternoon, talking and singing and piping upon the flageolette. We had a man cook to dress the dinner and sent for Jane to help us."

Mr. Pepys nowhere mentions the name of the surgeon who operated upon him, but we know from other sources that it was Thomas Hollyer, of St. Thomas's Hospital. Mistress Turner was the wife of John Turner, Serjeant at Law, who lived in Salisbury Court. She was Jane, daughter of John Pepys, of Ashtead, and as she lived next door to Pepys's father—who had a tailor's

shop in Salisbury Court, Fleet Street—it was convenient to have the operation in her house.

Thomas Hollyer, who operated, was appointed Surgeon for 'Scald heads' at St. Thomas's Hospital in 1638, and on Jan. 25, 1643–4, was chosen Surgeon to the Hospital in place of Edward Molines, Lithotomist to the Hospital. Molines was a Royalist and had been taken in arms against the Parliament at Arundel. He was deprived of his office of Surgeon to the Hospital on the day Hollyer was appointed. After the Restoration Molines was reinstated by order of the king, but as there was no vacancy he became fourth or additional Surgeon.

Hollyer's position as Lithotomist to the Hospital gave him unusual opportunities to perfect his skill in cutting for the stone, as we learn from the Diary of the Rev. John Ward, Vicar of Stratford-on-Avon, who says: "I was at St. Thomas' Hospital on 14th January (1661-2) where the porter told me that Mr. Hollyard cut 30 of ye stone in one year and all lived, and afterwards cut 4 and they all died." It was fortunate for Mr. Pepys as well as for the many generations who have read his *Diary* that he was operated upon before Hollyer and his instruments became septic. It is clear that Hollyer had the entire confidence of Pepys, for he bled him, gave him sound advice on several occasions, and was called in to see Mrs. Pepys when she was ill.

By a curious accident the Sloane Collection of Manuscripts at the British Museum contains two prescriptions written for Pepys on the occasion of his operation. The first is:—

℞	Pulv. glyc. rad.	℥iii	Lactis vaccinæ	
	Rad. Altheæ	℥ii	Aq. rosarum rub.	lb. iss
	Fol. Malv.	M.* iiii	Alb. Ovorum No. xv.	
	Cinnamomi fract.	℥iss		

Misce ante et distillantur lento igne.

Sumate hujus ℥vi; Syrup. altheæ ℥i½ omni mane et horâ somni quotidie.

Mr. Peapes. Dr. J. M.

* M. is the symbol for a handful.

On the next page of the Sloane MS. is a second prescription for a draught to be in readiness when he was cut, and is subscribed, "For Mr. Peapes who was cut for ye stone by Mr. Hollyer, ye 28 March 1658 and had a very great stone taken that day for him." The prescription is signed Dr. J. M.; Dr. G. Jolly. Its chief constituent was lemon-juice, to which a little syrup of radishes was added. The prescription shows that Mr. Pepys was expected to be rather feverish after the operation, but that his physicians did not think that he was in any danger, for it is expressly stated that the mist. alba which it contained was to be 'sine moscho'. In those days musk was considered a sovereign remedy for all who were suffering from collapse or were dangerously ill, and few people died without a viaticum of musk.

The signatures attached to the prescriptions thus accidentally preserved enable us to carry the story of Pepys's operation a little further. The initials J. M. at the foot of each prescription are those of Dr. James Moleynes, the leading lithotomist of his day, the father of Edward Molines mentioned above, and in all probability the master and teacher of Thomas Hollyer. James Moleynes held the office of 'Surgeon for the Stone' both at St. Bartholomew's

SAMUEL PEPYS

and at St. Thomas's Hospitals. He had so good a position in the profession that the College of Physicians granted him the unusual privilege of a licence to administer internal medicines in surgical diseases. He signs the first prescription, therefore, alone and with his initials like a physician, for had he not held such a privilege he would, as a surgeon, have signed with his full name. He lived in Warwick Lane, and the minutes of the Court of Governors at St. Bartholomew's Hospital contain the following reference to his appointment as Lithotomist :—

" Vicesimo die Januarii Anno Dei 1622–3.

" It is ordered by the Governors of this Hospitall that James Mullins Chirurgion in consideracon of his care and paynes which he is to take in cuttinge and cureing of poor diseased persons of the Stone and the griefs and maladies hereunder named, brought to the several hospitals of St. Bartholomew's and St. Thomas' in Southwark shall have the yearly stipend of xxx*li.* per ann. from XXmas last past so long as he shall discharge the same cures to the good liking of the Governors of the said hospitals, viz. xv*l* of his said stipend to be paid him quarterly from this hospital and the other xv*l* from St. Thomas' Hospll. and he is also to be allowed two pounds of towe for every patient for theire more easie and warmer dressings."

Then follows a statement by Moleynes as to what he undertook to do in return for his thirty pounds :—

" For the annual stipend of thirty pounds I undertake (with God his helpe) my best skill and experience the manuall operation and chirurgical cuer of these issueinge Maladies viz.

" The Cureing by insition the stone in the yard or Bladder.

" The Cureing of the rupture or falling downe of the Intestines or gutts into the Codds, by Cuttinge.

" The cureinge by Insition the Carnosity or fleshie substance in the Codds (i.e., stricture of the urethra as it would now be called).

" Also the curing of Wenns by Insition.

" Desireing that for every patient I may have the allowaunce of 2 pounds of towe for theire easier and warmer dressinge."

The second prescription is signed by Dr. J[ames] M[ullins] and by Dr. G. Jolly.

Dr. Jolly was George Joyliffe, of Wadham and Pembroke Colleges, Oxford, who graduated B.A. in 1640 and was incorporated M.D. at Cambridge in 1652. He served as a lieutenant in the Royalist army under Lord Hopton, practised at Garlick Hill in London, and died there in November, 1658, a few months after he had attended Mr. Pepys, being barely forty years of age. He was a friend of Glisson, had been one of the discoverers of the lymphatics, and promised to be a distinguished man of science had not death cut short his career.

Pepys's natural curiosity led him to inquire about the operation which he had undergone. Accordingly on Feb. 27, 1662 :—

" Up and to my office, whither several persons came to me about office business. About 11 o'clock Commissioner Pett and I walked to Chirurgeon's Hall (we being all invited thither and promised to dine there); where we were led into the Theatre; and by and by comes the reader, Dr. Tearne,

with the Master and Company, in a very handsome manner; and all being settled, he began his lecture, this being the second upon the kidneys, ureters, &c. which was very fine; and his discourse being ended, we walked into the Hall, and there being great store of company, we had a fine dinner and good learned company, many Doctors of Phisique and we used with extraordinary great respect. After dinner Dr. Scarborough took some of his friends and I went along with them, to see the body alone, which we did, which was a lusty fellow, a seaman that was hanged for a robbery. I did touch the body with my bare hand; it felt cold, but methought it was a very unpleasant sight. Thence we went into a private room where I perceive they prepare the bodies, and there were the kidneys, ureters, &c. upon which he read to-day, and Dr. Scarborough upon my desire and the company's did show very clearly the manner of the disease of the stone and the cutting and all other questions that I could think of. . . . How the water comes into the bladder through the three skins or coats just as poor Dr. Jolly has heretofore told me. Thence, with great satisfaction to me, back to the Company, where I heard good discourse, and so to the afternoon Lecture upon the heart and lungs, &c. and that being done we broke up, took leave and back to the office."

The portrait is an etching by C. O. Murray from the painting by John Hayles in the National Portrait Gallery. It was painted in March, 1665—the Plague year. Pepys says of it, "This day I begin to sit and he will make me, I think, a very fine picture and I sit to have it full of shadows and do almost break my neck looking over my shoulder to make the posture for him to work by." On March 30: "And so to Hales's and there sat till allmost quite darke upon working my gowne which I hired to be drawn in: an Indian gown, and I do see all the reason to expect a most excellent picture of it." On May 16: "Thence to Mr. Hales and paid him for my picture—£14 for the picture and 25s. for the frame."

THE USE OF LOCAL ANÆSTHESIA IN THE TREATMENT OF FRACTURES, WITH CONCLUSIONS DRAWN FROM FIFTY CASES.*

By JOHN P. HOSFORD, London.

As long ago as 1885 Conway reported four cases in which he had used local anæsthesia while setting fractures. He used 4 per cent cocaine, and reported its use in three cases of Colles's fracture and one of a posterior dislocation at the elbow-joint. In 1903 Reclus reported a case in which he had used local anæsthesia to transport a patient with fractured femur in comfort. Four years later Lerda reported thirty cases in which he had used local anæsthesia, and in the following year Quénu recorded fifteen cases. Braun in 1913 described fifty cases in which either local infiltration at the site of fracture or brachial plexus anæsthesia or other forms of conduction anæsthesia were used. In 1921 Fulton in London described in a short article five cases where he had used 1 per cent novocain in setting fractures, and he had good results with its use in all except one. Since then a number of articles have appeared in the foreign literature recording its successful use. Rice describes in some detail the technique for local anæsthesia in cases of Colles's fracture by infiltration with 1 per cent novocain around the site of fracture. It has been used in Böhler's fracture clinic in Vienna in some thousands of cases with success. He uses 2 per cent novocain and injects it directly into the site of fracture.

Various Uses of Local Anæsthesia.—There are several different purposes for which local anæsthesia may be employed in treating fractures. Foremost amongst these is its use for relieving pain and abolishing muscle spasm while a fracture of almost any bone is being reduced and splinted. In fractured femur cases it can be used to overcome pain while the apparatus for skin or skeletal traction and the necessary splint are being put into position and applied to the leg. For skeletal traction either a caliper may be applied or a pin may be passed painlessly through the bone under the effect of local anæsthesia. For obtaining traction in difficult cases of fractured phalanges novocain anæsthesia may be used for passing a sharp steel wire through the pulp of the finger. It may also be used with considerable advantage in cases where a patient with a fracture of a large bone, especially the femur, has to be transported either a short or a long distance, as the shock and mental distress from the pain and muscle spasm brought on by the almost unavoidable jolting associated with the journey can be greatly alleviated. It must, of course, be remembered that during transport the limb should be securely splinted, lest, with the pain abolished, a patient may be tempted to move the

* From the Surgical Professorial Unit, St. Bartholomew's Hospital.

limb and so do serious damage thereto. In the present series of cases local anæsthesia has been used for all these purposes.

Methods of Using Novocain in Fractures.—

1. The whole area around the fracture may be infiltrated with novocain introduced through several punctures on different sides of the limb.

2. Novocain is injected directly into the hæmatoma at the site of the fracture between the bone fragments. A hæmatoma is always present and extends to all parts of the fracture; thus the anæsthetic solution will reach all the fractured surfaces of bone. If one bone is fractured in two or more places, or if more than one bone is fractured, then it will be necessary to make more than one injection.

3. By injecting suitable peripheral nerves on the proximal side of a fracture in a limb it is possible to relieve pain and muscle spasm at the site of the fracture.

4. In open fractures, or in otherwise difficult fractures in the upper limb, anæsthesia may be obtained by injecting novocain into the brachial plexus.

5. In the lower extremity, with similarly complicated cases, spinal anæsthesia may be used.

Advantages of Local Anæsthesia.—The use of local anæsthesia has many advantages over general anæsthesia. The most obvious, though by no means the most important, is its use in those patients who, on account of age or for other reasons, are unfit for a general anæsthetic; and it cannot be too strongly emphasized that for setting and splinting fractures properly it is almost invariably necessary to have an anæsthetic much deeper and more prolonged than 'a whiff of gas'. When working alone, local anæsthesia overcomes the difficulty of being without an anæsthetist. Some patients who absolutely refuse to have a general anæsthetic will agree to local anæsthesia. In severely shocked patients a fracture may be safely 'put up' at an earlier date than if a general anæsthetic has to be used.

More often than not the advantages already given (though they are obvious ones) will not appear in the majority of cases. The following advantages, however, are very real, and are present in many instances.

While reducing the fracture and reviewing the correct position and applying splintage the surgeon has the co-operation of the patient. For example, in the case of a severe eversion fracture-dislocation in the region of the ankle-joint it is convenient to have the patient sitting on a high table with the legs hanging over the end, and after reduction is apparently obtained its completeness or otherwise can be well determined by asking the patient to move his ankle while at the same time the surgeon holds the malleoli firmly between his hands. Only if reduction is satisfactory will these active movements on the part of the patient appear normal. It is also extremely instructive, as well as helpful, in the case of a Colles's fracture to see the improvement in the range of active movement which occurs as the fragments are brought into the correct position. This effect, of course, is entirely lost with a patient under general anæsthesia, since passive movements do not truly represent active movements. The advantage of the patient's co-operation and consciousness with local anæsthesia is also very evident in cases of fracture at the upper end

of the humerus, where it is necessary to apply some form of shoulder abduction splint other than plaster, because the only thing more difficult than fitting such a splint to an unconscious person lying down is fitting it to a patient who is being held in a sitting position while under the influence of a general anæsthetic. With the patient sitting down and freed from pain and muscle spasm by local anæsthesia, the reduction of a difficult fracture at the upper end of the humerus is as easy as it ever is, and the application of the splint is perfectly simple.

For patients who are going to proceed home immediately after the reduction of the fracture, local anæsthesia has a great advantage, as it is rare for nitrous oxide to be a really efficient anæsthesia for the proper reduction and splinting of a fracture.

Similarly, the immediate X-raying of a patient after reducing a fracture under local anæsthesia, instead of perhaps waiting until the following day, when he will have recovered from a general anæsthetic, is a great advantage. This is actually one of the greatest advantages, because if on the immediate development of the skiagram the position of the fragments is seen to be unsatisfactory, the splints may be removed, the position of the fragments altered, and re-splinting done without any fresh anæsthetic being required. With general anæsthesia there is sometimes a tendency to allow an only moderate position to pass owing to the patient's objection to having another anæsthetic so soon, or to the difficulties of obtaining an anæsthetist.

On the few occasions when a surgeon wishes to set a fracture under the X-ray screen local anæsthesia has most obvious advantages.

Disadvantages and Contra-indications.—In very young children local anæsthesia for setting a fracture is clearly not convenient. The youngest child in this series of cases was 7 years old, and she neither cried nor complained while the position of her fractured tibia was corrected under local anæsthesia.

In cases where it is impossible or very inconvenient to obtain a skiagram when a fracture is first seen, general anæsthesia is more certain to give good results than local anæsthesia, except in the case of typical classical fractures, because without skiagrams the general alinement of fragments can in most cases be well obtained under general anæsthesia; whereas without skiagrams, when much swelling is present, and especially where there is more than one fracture, it is difficult to inject novocain exactly at the site of fracture.

The time taken when using local anæsthesia is a little longer than in the case of general anæsthesia.

Sometimes it is not possible to obtain novocain at short notice and there is a slight amount of trouble involved in preparing it, but if a small stock of solid novocain is kept, a solution is easily and quickly prepared (*see below*).

In cases of open fractures local injection at the site of the fracture is contra-indicated. In such cases either general anæsthesia or brachial-plexus block or spinal anæsthesia may be used. With an extensive injury of the lower extremity it may be extremely difficult and painful to the patient to roll him on his side or sit him up to perform lumbar puncture, and so general anæsthesia must of necessity be used.

Risk of introducing infection by injecting novocain into fractures might

be advanced as a contra-indication to its general use, but with ordinary care this should not arise. In no single case in this series was there the slightest evidence of infection. In Böhler's fracture clinic, where novocain has been used in a very large number of cases to the complete exclusion of general anæsthesia, it is claimed that no case of infection has occurred.

CASE REPORTS.

During the last year local anæsthesia has been used in the treatment of fractures in the Surgical Professorial Unit at St. Bartholomew's Hospital on many occasions. Excellent results have been obtained with its use in fractures of nearly all the long bones. It has been used in fractures of the following bones :—

Clavicle
Humerus—
(*a*) Surgical neck
(*b*) Shaft
(*c*) Supracondylar fracture
Radius—
Lower end (many different degrees and varieties, including separation of the distal epiphysis).
Carpal scaphoid
Metacarpals
Phalanges—
Multiple fractures with lacerated hand
Femur
Tibia—
(*a*) External condyle
(*b*) Shaft
Fibula—
External malleolus
Tibia and fibula—
(*a*) Fractures of shafts of both bones
(*b*) Fracture-dislocations of ankle-joint, involving tibia and fibula. (Many degrees and varieties.)

It has also been used for introducing Steinmann's pins for obtaining skeletal traction in cases of fractured femur and tibia. The pin has been put through the tuberosity of the tibia in the former case and through the os calcis in the latter.

The following 10 cases out of the series of 50 will serve to show the use of local anæsthesia in treating various types of fractures.

Case 1.—**Male, age 34. City police constable. Fractured shaft of left humerus.**

Considerable angulation and much pain. Nineteen hours after fracture 50 c.c. of 2 per cent novocain were injected, half the quantity from the posterior and half from the anterior aspect. In about five minutes the temporary splint with which the patient had arrived was removed and the angulation at the site of fracture corrected by manual traction. This was done easily and without causing pain, whereas previously the slightest movement had caused intense pain. The arm was put in a Thomas arm splint with fixed extension. *Fig.* 403 shows the fracture as seen immediately after this reduction. The shortening had been very easily overcome, as the muscle spasm while putting up the fracture had been abolished. The patient returned to duty in eleven weeks.

Case 2.—**Female, age 21. Typist. Colles's fracture of left wrist.**

Fig. 404 shows the extremely severe displacement : 20 c.c. of 2 per cent novocain solution were injected dorsally and 10 c.c. antero-laterally five hours after the accident. Perfect anæsthesia and muscle relaxation were obtained while the fracture was reduced. *Fig.* 405 shows the position after the reduction. The patient was in tears and extremely nervous before the injection was begun, but after the reduction voluntarily admitted that it had not hurt 'the slightest bit', and proceeded immediately to the X-ray department to have the position checked.

FIG. 403.—*Case* 1. Fracture of humerus reduced under local anæsthesia.

FIG. 404.—*Case* 2. Colles's fracture before reduction. Extreme backward tilting as well as backward displacement.

FIG. 405.—*Case* 2. After reduction, with dorsal plaster splint in position.

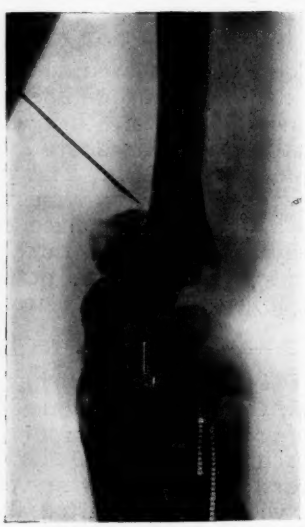

FIG. 406.—The position of the needle while injecting a Colles's fracture.

Fig. 406 shows the best angle at which to inject the solution from the dorsal surface, and the position, with relation to the fragments, at which one aims at putting the solution. In *Fig.* 407 the line indicates the site of a Colles's fracture, and the needle is put in about three-quarters of an inch, more or less (depending on the amount of fat and swelling present), proximal to the fracture.

Case 3.—**Male, age 9. Displaced distal radial epiphysis.**

There was considerable dorsal displacement of the epiphysis: 15 c.c. of 2 per cent novocain were injected dorsally, and perfect anæsthesia and reduction were obtained. The recovery was uneventful, and the result perfect.

Case 4.—**Male, age 29. Fractured carpal scaphoid.**

There was a fracture of the ordinary 'snapped-waist' variety with some pulverizing of bone, with the latero-distal fragment somewhat rotated. There was much pain and muscle spasm, so that it was impossible to dorsiflex the wrist. About nine hours after the accident 15 c.c. of 2 per cent novocain were injected to the site of fracture by way of the anatomical snuff-box; at the same time the hand was deviated towards the ulnar side somewhat. The relief from pain and muscle spasm, though not complete, was then sufficient to allow the hand to be dorsiflexed to a satisfactory position, and it was maintained by a plaster cast.

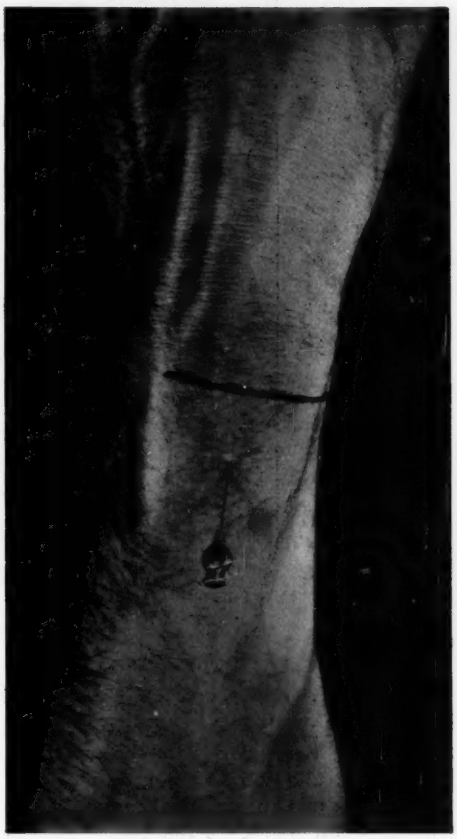

FIG. 407.—Dorsum of forearm and hand. The level of a Colles's fracture is indicated, and the site for injection shown.

Case 5.—**Female, age 22. Fractured femur.**

There was an almost transverse fracture of the middle of the shaft of the femur: 60 c.c. of 2 per cent novocain were injected at the site of fracture and 10 c.c. at each side of the tuberosity of the tibia. A Steinmann's pin was then passed through the tibial tuberosity, and a weight attached to it by a cord over a pulley, after the leg had been adjusted in a Thomas splint. The movements necessarily associated with these procedures caused no pain at all in the femur, and the sight of the pin through her tibia surprised the patient, as she had not felt the slightest pain while it was being hammered in, although she felt the hammering. Often the periosteum is slightly sensitive, though the other tissues may have been well anæsthetized.

Case 6.—**Male, age 50. Licensed victualler. Fracture-dislocation of ankle-joint.**

Fig. 408 shows the very severe backward displacement, and the position of the fibula shows the great rotation. There was also great eversion. On the same day as the accident 30 c.c. of 2 per cent novocain were injected antero-internally below the projecting lower end of the tibia, and 10 c.c. antero-externally. These injections went into the ankle-joint, and perfect anæsthesia and abolition of muscle spasm were obtained so that reduction was easy. The patient then carried out active movements, and crepitus was felt as the foot was held in position, but this

caused no pain. Good position was obtained, and in seventeen weeks the patient was discharged from treatment with a good ankle.

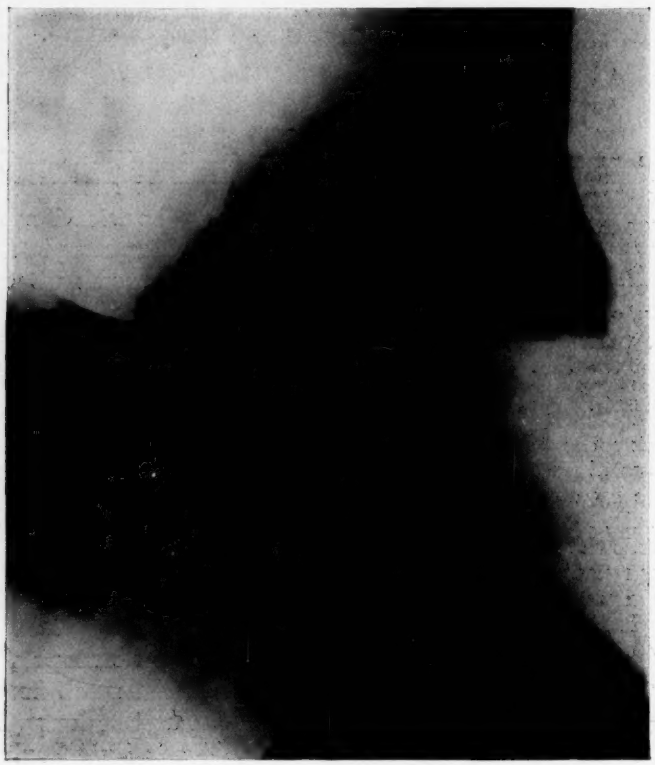

FIG. 408.—*Case* 6. Pott's fracture-dislocation at the ankle-joint.

Case 7.—**Male, age 43. Carman. Lateral dislocation at ankle.**

Fig. 409 shows the unusual dislocation at the ankle. The astragalus with the fibula has been displaced laterally away from the tibia, but there was no fracture except at the very upper end of the fibula: 52 c.c. of 2 per cent novocain were injected on the internal aspect immediately anterior to the internal malleolus. Apart from the first needle prick the patient experienced no pain at all. Perfect position was obtained.

Case 8.—**Female, age 61. Pott's fracture.**

Fig. 410 shows the fracture, and the considerable lateral displacement: 25 c.c. of 2 per cent novocain were injected into the comminuted fracture of the fibula and 25 c.c. antero-internally, in the region of the internal malleolus, into the ankle-joint. Extremely large fracture blisters were present at the time of injection. No pain was felt at the time of reduction or during the application of the plaster. The patient obtained excellent function, and the position was good.

Case 9.—**Male, age 52. Fractured tibia. Steinmann's pin in os calcis.**

There was an oblique fracture at the junction of the middle and lower thirds of the tibia, with considerable shortening. A week after the accident a Steinmann's pin was passed through the os calcis after injecting 10 c.c. of 2 per cent novocain solution at each side. There was slight pain only as the pin penetrated the periosteum.

Case 10.—**Male, age 18. Lacerated hand with multiple fractures.**

Brachial-plexus anæsthesia after the method of Kulenkampff was used, as there were extensive lacerations of the palm and fingers, and fractures of phalanges in the thumb, index, and middle finger. Ten c.c. of 2 per cent novocain were injected into the plexus above the clavicle, and a further 10 c.c. around it. Good anæsthesia was obtained in the hand, except over the little finger and ulnar side of the hand; this part, however, was not injured.

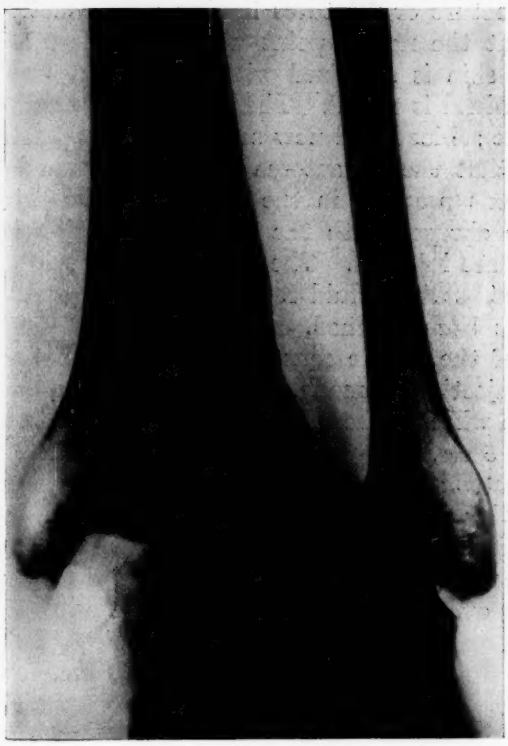

FIG. 409.—*Case* 7. Lateral dislocation at ankle-joint with tearing of interosseous ligament between tibia and fibula.

FIG. 410.—*Case* 8. Eversion fracture-dislocation at the ankle-joint before reduction. There was no backward displacement at the ankle.

Local Anæsthetic Used.—In all except two cases a 2 per cent solution of novocain in normal saline has been used. A 0·5 per cent solution was used in the case of two Colles's fractures, but the results obtained were not so satisfactory as with the stronger solution.

The novocain solution is always freshly prepared by boiling either 50 c.c. or 100 c.c. of normal saline in a flask. It is then removed from the gas-ring, and either 1 or 2 grm. of solid novocain is added and the solution brought to the boil again only for a few seconds. Adrenalin has not been used; it is apparently not necessary, because the novocain is injected directly into the hæmatoma and there is not the rapid absorption and removal of the novocain that occurs when it is injected into normal tissues.

The quantities injected have varied from 10 to 144 c.c. The latter quantity was used in the case of a patient who had fractured her femur, tibia,

and fibula, and in addition to injecting fractures in these bones injections of novocain were also made on both sides of the tuberosity of the tibia for the introduction of a Steinmann's pin. Although the quantity injected in this case at one sitting was 144 c.c. there were no apparent toxic effects, nor have there been in any case in this series.

Technique of Injection.—In this series the method employed has been that of injecting the novocain solution directly into the hæmatoma. The site of injury is X-rayed, and, the fracture or fractures having been exactly located, the injection is made so that the needle point will go as close as possible to the fractured ends. The skin is sterilized with ether only, and with the finest hypodermic needle a wheal is raised. Then a 0·8-mm. needle is passed directly down to the fracture; blood will now sometimes flow back through the needle, and this means that the hæmatoma has been reached; usually, however, there is not sufficient pressure in the hæmatoma for this to occur. A 10-c.c. or 20-c.c. syringe charged with the novocain solution is now attached to the needle and 5 c.c. are injected. The piston of the syringe is then withdrawn a little, and if blood-stained fluid returns into the barrel, it is known that the hæmatoma has been reached. If blood-stained fluid cannot be withdrawn, the position of the needle must be altered until the hæmatoma is found, and then the injection is made. One can usually tell before actually withdrawing the piston whether the needle is in the hæmatoma or not, as during the injection of the 5 c.c. the piston is very easily pushed down if the hæmatoma is being injected; whereas if the injection is being made directly against normal bone where there is no hæmatoma, the piston has to be forced down fairly hard. However, although the piston may apparently be easily pushed home, the precaution of first withdrawing it and seeing the blood-stained fluid should not be overlooked.

No rule can be given as to the quantity it is necessary to inject, but about 20 c.c. has usually been used for Colles's fractures, 40 to 50 c.c. for Pott's fractures, and 20 to 40 c.c. for fractures of the shaft of the tibia, depending upon whether they are comminuted or not. The needle is then removed and gentle pressure kept on the site of puncture for about five minutes. A piece of sterile gauze is laid over the area and manipulation is carried out, as by this time anæsthesia is usually satisfactory and muscle spasm abolished. In a few cases where anæsthesia has not been complete a further injection has been made, approaching the fracture from a different direction, as usually the primary failure is due, not to an insufficient quantity of solution having been injected, but to its not having reached both sides of the fracture, owing, perhaps, to impaction of the fragments. In most cases, except for the prick of the first needle, no pain is caused by the injection, though sometimes there is a slight sickening pain as the needle encounters the periosteum. As regards the length of time after the fracture at which anæsthesia can be obtained, no limit can be given from this series, as the longest period after the fracture that the injection was made was five days, and then good anæsthesia was obtained.

Results of the Use of Local Anæsthesia.—In only one case was there a complete failure to obtain relief of pain and muscle spasm, so that general anæsthesia had to be resorted to. This was a case of fracture of the lower

end of the tibia and fibula without displacement. There was a considerable amount of swelling, so that it was not possible to palpate the fragments, and a skiagram had not been taken. Failure here was obviously due to mistaking the level of the fracture in the tibia, as it was actually two inches higher than was thought at the time. In another case, that of fractures of the second and third metacarpals, where skiagrams had not been previously taken, there was no relief from pain after the injection, but the correction of the angulation was proceeded with and a satisfactory position obtained. In a third case, which was done at night almost immediately after the fracture had occurred (no skiagrams had been taken), there was not complete relief of pain, because what was thought to be a single oblique fracture of the shaft of the tibia was actually a double one and only the lower one had been injected; however, though there was not complete relief from pain at the manipulation, the patient did not complain while a plaster cast was being applied, and the rigid protective spasm which was present had disappeared. Perfect position was obtained. Thus, out of about fifty cases only three may be said to have been failures when using 2 per cent novocain. In the other cases it has been quite surprising to see what perfect relief from pain and excellent abolition of muscle spasm has been obtained. The patients themselves have frequently remarked that they have felt the bone slip back into place, but that it does not hurt, and then, when a full range of active movements has been carried out and crepitus can be felt, the patient has watched it uncomplaining and with interest.

In cases where 'fracture blisters' have been present at the time of injection these have been avoided with the needle; and, especially in one case, it was interesting to note how the blister increased in size as the injection of novocain was made into the fracture at some distance from the blister.

There has been no case in which there has been any evidence of infection having been carried into the fracture, nor any instance of toxic effect having occurred from the novocain.

CONCLUSIONS.

1. Local anæsthesia for setting fractures, when performed by injecting 2 per cent novocain directly into the hæmatoma which surrounds all parts of the fracture, is a safe and practicable procedure.

2. Beyond the prick of the first hypodermic needle there should be no pain, except occasionally as the needle penetrates the periosteum, and sometimes as the bruised soft tissues are pressed upon during reduction. The latter, however, only occurs in fractures due to direct violence.

3. Muscular relaxation should be as good as it is with general ether anæsthesia, and better than is usually obtained with nitrous oxide.

4. Skiagrams should always be taken before injecting the novocain so as to be as certain as possible of getting the solution between, or against, the fragments, as failure to do this is almost invariably the cause of failure to bring about relief of pain and relaxation of muscle spasm, provided a freshly prepared 2 per cent solution of novocain is used.

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THE VASCULAR COMPLICATIONS OF CERVICAL RIB.*

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THE existence of a cervical rib may lead to symptoms which are predominantly sensory, motor, or vascular. The sensory and motor phenomena have been described on many occasions and there is general agreement as to their main features. The vascular symptoms are, however, much rarer, and still present many points of difficulty in their interpretation.

The following study is based on personal experience of three cases of cervical rib in which the prominent symptoms were due to thrombotic obliteration of the arteries of the arm. A short account of the three cases follows :—

Case 1.—E. S., male, age 57, was first seen on Nov. 9, 1929.

HISTORY.—The patient had been a vanman all his life, driving horses till 1915, and after that date handling a motor lorry. He had had no illness and had never lost a day's work, but twelve months before admission to hospital he noticed that the fingers of his right hand, more especially the index, were white and painful. He continued at his work, which involved handling heavy packages, until Easter, when, his hand being much worse and an ulcer appearing at the base of the nail of the index finger, he was obliged to give up. The hand became weaker and the pain worse so that he lost much sleep.

ON ADMISSION.—The condition of the right hand was as shown in *Fig.* 411. The whole index finger was in a state of dry gangrene and the distal halves of the remaining fingers were all in a condition of impending gangrene. No arterial pulse could be felt anywhere in the arm below a point one inch higher than the lower border of the pectoralis major tendon. Above this point there was a very distinct and thumping pulse—the third stage of the subclavian artery pulsating visibly. A routine examination of the pulse throughout the rest of the body showed that it was everywhere normal.

There was no wasting of the small muscles of the hand, and sensation to cotton-wool and pin-prick was normal everywhere excepting over the gangrenous areas. The patient was a thin man obviously worn by pain and loss of sleep. The Wassermann reaction had been done before admission: it was reported negative, and was repeated after admission with a like result.

OPERATION (Nov. 11).—A portion of the cervical rib was excised. The subclavian artery and the lowest trunk of the brachial plexus were dissected very deliberately and with great care so that their relations to the rib might be observed with the least possible disturbance. It was apparent that the subclavian artery was in no way embarrassed; the vessel passed freely over the rib with a good clearance and no mark of any pressure. The lowest trunk of the plexus was lying

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hard on the rib in the notch shown in the photograph of the excised bone (*Fig.* 412). The removal of the rib was quite easy in spite of the fact that the more simple subperiosteal resection was not done; in fact, it ought never to be done, since to leave the periosteum is to risk a recurrence of the rib.

FIG. 411.—*Case* 1. Condition of hand before operation.

FIG. 412.—Portion of rib excised in *Case* 1, showing groove in which the lower trunk of the brachial plexus was found.

AFTER-HISTORY.—The operation was followed, as is usual in these cases, by very prompt relief of pain, and the man in fact slept through the following night without assistance. The hand showed a rapid improvement, and at the end of a fortnight it was evident that all the fingers were recovering with the exception of the index, at the base of which a striking line of demarcation had appeared.

There was steady improvement in the condition of the hand, and at the end of three months a distinct pulse was to be traced in the superior profunda, with obvious enlargement of this vessel. Shortly afterwards the index finger came away at the metacarpo-phalangeal joint, and small portions of the tips of the middle and ring fingers also exfoliated.

The hand is now—eight months after the operation—everywhere of normal colour, and excepting for the loss of the portions mentioned is normal. No pulse other than that of the superior profunda has been felt at any time. The improvement in the man's condition is very apparent: he rapidly recovered in weight the

stone and a half which he had lost in the latter part of his illness, and has now returned to his work.

Two similar cases have been described in detail by one of us (E. D. T.),[1] and a brief summary of these is as follows :—

Case 2.—Male, age 27, admitted to the Manchester Royal Infirmary on March 13, 1912, with the following history : For twelve months he had noticed that his right index finger was numb and white. This condition gradually extended to the thumb and middle finger, and by the end of the year had involved the whole of the hand. No arterial pulse was felt in the main vessels up to a point one inch below the anterior axillary fold. The pulseless arteries could be felt as solid cords. Pulsation in the axillary and subclavian arteries was very marked, and the case had in fact been sent for consultation with a diagnosis of subclavian aneurysm. The cervical rib was removed, and when the man was examined some twelve months afterwards, recovery was complete and he was doing his full work. In this case the inferior profunda was soon felt to be enlarged, and in fifteen months normal pulsation returned in radial and ulnar arteries, but the lower half of the brachial artery remained occluded.

Case 3.—Female, age 29, admitted to the Manchester Royal Infirmary on Sept. 16, 1912, complaining of deadness and loss of use in the right arm. Six months before admission the tip of the index finger became numb and painful, and soon afterwards a large portion of its pulp became gangrenous and sloughed off. Within a month the whole hand was cold and numb. On examination the arterial pulse was not found below the level of the insertion of the coraco-brachialis, but from this point upwards the arteries were normal. A cervical rib of considerable size was removed, and at the end of six months recovery was complete and the patient was back at her work as a weaver. In this case, although colour and use of hand were perfect, no pulse could be felt one year afterwards at any point below the occluded brachial artery. A portion of the radial artery was excised, and the histological findings were described by Todd.[2]

The similarity of these three cases in their symptoms, physical signs, and recovery after operation is very striking. In each case the patient was right-handed, and the condition is obviously related to the presence of a cervical rib on the side most used at work. It is not easy to understand why the index finger leads the way in the development of the disease ; there does not appear to be an anatomical explanation of this fact. The cases agree entirely in the very gradual onset, the initial pallor, coldness, and numbness, the occurrence of gangrene, and the cessation of all pulse at a point about the junction of the axillary and brachial arteries. They all agree, finally, in the very complete recovery which has followed on the removal of a cervical rib.

What, then, is the explanation of this clearly defined symptom-complex ? When one turns to consult the text-books on surgery, one is surprised to find that where any explanation is given it is usually that of direct pressure on the subclavian artery. We maintain that any such explanation is untenable : it will not bear critical examination for a moment. It is, in the first place, most unlikely that in a healthy patient the sudden interruption of the subclavian artery by ligature would produce gangrene of even as much as a finger-tip, and it is ridiculous to suggest that any very gradually increasing pressure on the vessel would cause such a result. One of us had occasion recently to ligature the third stage of the subclavian artery together with the transversalis colli and suprascapular arteries in a man of 59 with advanced

atheroma, and not the least threat of gangrene supervened. Further, the most superficial examination of these cases shows that a strong pulse is present in both the subclavian and axillary arteries. This pulse is so marked that the patients have at times been labelled with a diagnosis of " aneurysm of the third stage of the subclavian artery ".

In each of the three cases mentioned above the operator has approached the artery with a minimum disturbance of the parts, and in none of the three cases has there been the slightest evidence of any pressure on the vessel, even with the shoulder fully depressed in the classical position for ligature of the artery. It is quite plain that the explanation of pressure on the artery will not do, and we must seek the cause in the relation of the lowest trunk of the plexus to the cervical rib.

In this connection there is another observation which has an important bearing upon the question, and that is the distribution of the vascular occlusion. It is very significant that in each of the three patients this ended abruptly in the region of the lower border of the insertion of the pectoralis major muscle. This means, in the light of recent anatomical research, that the occlusion was limited to those vessels receiving their vasomotor supply from the peripheral nerves, and did not appear in the subclavian and axillary arteries, which are innervated by sympathetic fibres extending out to the arm as a perivascular plexus.

The nerve-fibres accompanying the two large arteries, subclavian and axillary, are remote from the rib and could not be exposed to irritation, or pressure from a rib, and the vessels which they supply were in all three patients quite healthy and normal—whereas the brachial and forearm arteries, which are innervated by sympathetic fibres entering the trunks of the brachial plexus, were occluded. The distribution of the vascular disturbance gives a further reason for studying the lowest trunk in order to explain the symptom-complex which these patients manifest. We are at once faced with the problem of why in one case of cervical rib the symptoms may be purely sensory and motor, whilst in another the results are predominantly thrombotic.

Todd[3] was the first to suggest that the cases with vascular symptoms are due to the pressure of the cervical rib upon that portion of the sympathetic which enters the arm via the lowest trunk of the plexus. There can be little doubt that Todd's explanation is the correct one, but it falls short of a complete explanation inasmuch as it does not attempt to explain the mechanism of the thrombosis. Further, there must be some reason why, out of a number of cases suffering from pressure on the lowest trunk of the plexus, only a small proportion will show vascular complications.

With the object of determining the position of the unmyelinated sympathetic fibres in the lowest trunk, transverse histological sections were prepared of this part of the plexus, at the point where it was in most intimate relation with the first rib, on both sides, in eight dissecting-room subjects. It was found that usually the sympathetic fibres were not confined to one particular part of the trunk, but were scattered amongst the myelinated fibres. There was, however, a slight tendency for them to reside principally around the circumference of the trunk. In one case the sympathetic fibres formed a

distinct and separate bundle in the inferior part of the trunk—that is, nearest to the rib (*Fig.* 413). The appearance suggested that the fusion of sympathetic fibres with the lowest trunk was at a more distal point than usual, and that in the region where the section had been cut they had not yet become fully incorporated with the other constituent fibres of the trunk. Todd has reported a similar finding in certain cases.

Such a position would clearly cause the sympathetic fibres to be more exposed to the risk of irritation or pressure by the rib than the motor and sensory fibres would be, and may explain why occasionally in patients suffering from rib pressure the vascular symptoms predominate and may be the only ones.

It appears evident that the arrangement of the sympathetic fibres in the lowest trunk is not absolutely constant, and that they occasionally form a separate bundle in apposition with the rib, where they may be exposed to friction or pressure. In a previous paper[4] we have considered the factors which induce an abnormally intimate relation between the lowest trunk and a cervical or first dorsal rib and thus lead to irritation or compression of the constituent fibres in the trunk. Briefly these may be summarized under three heads: (1) The anatomical relationship of the lowest trunk and rib; (2) Descent of the shoulder during development; (3) Muscular support of the shoulder. Excluding the cases due to trauma, we believe that weakness and loss of tone in the muscles which support the pectoral girdle, especially the trapezius, are the important causes of the onset of the symptoms. In slight degrees of depression of the shoulder the lowest trunk will be only slightly compressed, and friction, with consequent irritation of the fibres, will ensue. When the depression of the shoulder is considerable, progressive compression of the lowest trunk is brought about, with consequent paralysis of vasomotor, motor, and sensory fibres.

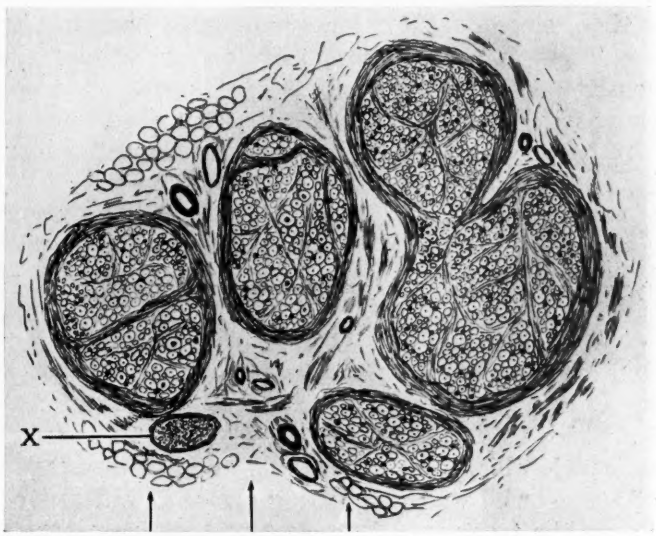

FIG. 413.—Section of lower trunk of brachial plexus in which sympathetic fibres were in an isolated bundle in relation with rib. X = position of bundle; the arrows indicate the region exposed to rib.

The initial symptoms in the three cases recorded were pallor and hypothermia, which indicate vasoconstriction, from irritation—not paralysis—of the sympathetic fibres. It is important to bear in mind that *paralysis* of vasomotor fibres never seems to induce vascular changes. One of us

(J. S. B. S.) followed over many years a number of irreparable divisions of peripheral nerves, and frequent examinations of the patients failed to reveal any tendency to arterial occlusion in consequence of paralysis of the vasoconstrictors. On the other hand, partial division and irritation of peripheral nerves has been found on several occasions to be succeeded by vascular changes, and these have been shown histologically.[5] Previous observers seem to have assumed that in the cases under consideration the sympathetic fibres were paralysed by the pressure of the rib, but there are at least three facts which oppose such a contention: (1) The initial pallor and symptoms of vasoconstriction; (2) The knowledge that paralysis of sympathetic fibres, even when long continued, never leads in itself to vascular occlusion, whereas irritation of a peripheral nerve has been shown to be associated with arterial changes; (3) The immediate relief of the vascular symptoms after operation—which could not occur if the sympathetic fibres had been paralysed for so long a time, since degeneration would have been inevitable.

There is good reason, therefore, to believe that irritation of the vasoconstrictor fibres in the lowest trunk of the plexus by a rib is the fundamental cause of the pallor, hypothermia, and vascular pain. There arises the question whether the irritation and consequent prolonged vasoconstriction can induce arterial occlusion. We would put forward the suggestion that the spasm of the arteries must inevitably induce constriction or even obliteration of their vasa vasorum. Prolonged narrowing or occlusion of the vasa vasorum is likely to cause nutritional changes in the walls of the arteries and to lead ultimately to thrombosis.

The matter might be put to experimental test, but the difficulty is to find any method by which long-continued irritation of sympathetic fibres can be artificially produced. It is hoped in the near future to devise some method by which this may be accomplished. In the meantime perhaps the nearest approach which can be made to an experimentally produced constant spasm of the arterial wall is by using ergot. Dr. Macdonald very kindly undertook for us the treatment of two white Leghorn cockerels by ergot in the Department of Pharmacology in the University of Manchester. In the one case the bird was given ½ grm. of ground ergot in its food daily for two months; the second bird was given a daily intramuscular injection of 0·2 c.c. of a 0·1 per cent solution of ergotamine tartrate (Stoll) during a period of six weeks. The big florid combs shrank steadily until they were reduced to one-tenth of their original size and their appearance was that of dirty chamois leather. At this stage sections of the combs were cut, and these show that the arteries are the seat of a proliferative endarteritis, whilst the lumen is occupied by a hyaline thrombus. These appearances are shown in *Fig.* 414. It is noteworthy that the change is most marked, and evidently begins, in the smaller arteries, extending subsequently to the large axial artery of the comb. The veins are quite unaffected. Our findings in this respect agree entirely with those given by von Recklinghausen.[6]

It is likely, therefore, that the vascular changes when seen in cases of cervical rib are due to prolonged spasm and resemble those of ergotism. Clinical observation of the cervical rib cases shows that the changes begin, and are always most extreme, in the small vessels at the periphery. The

thrombosis here induced spreads subsequently to the larger vessels. In one patient this process was evident. When first seen he had a good pulse in the brachial artery at the bend of the elbow, but during the few days he was awaiting admission to hospital the thrombosis gradually ascended and involved the whole of the brachial artery.

Our interpretation of these cases of gangrene associated with the presence of a cervical rib is that in some patients the bundle of sympathetic fibres which is destined to innervate the peripheral vessels of the arm lies in the lowest trunk of the plexus in such a position that it is exposed to pressure from the rib. This pressure causes irritation of these fibres, with consequent spasm of the arterial wall. The persistent spasm of the wall of the artery must embarrass the vasa vasorum and lead to changes in the health of the

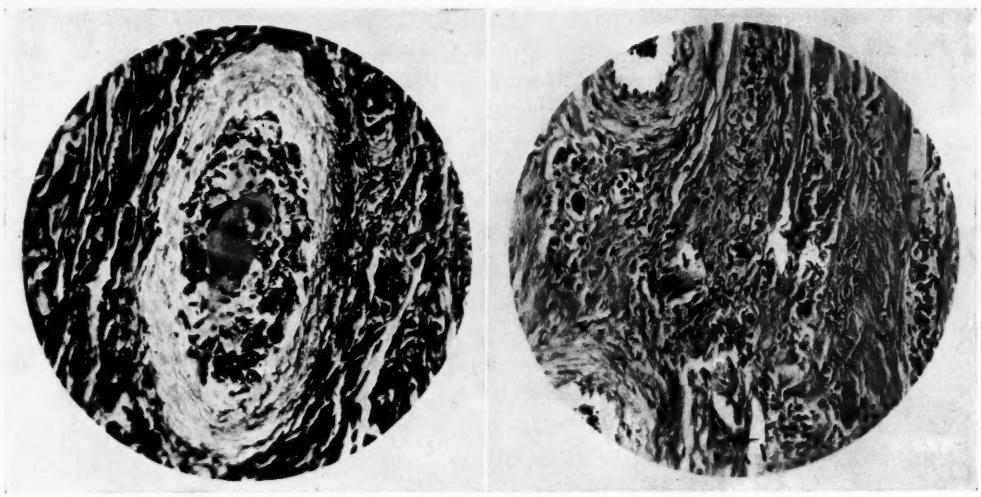

FIG. 414.—Sections of the combs of Leghorn cockerels after injection of ergotamine tartrate, to show proliferative endarteritis and, in that on the left, the presence of a hyaline thrombus in the lumen. (× 200.)

arterial wall. The thrombosis is secondary to these changes. That portion of the main trunk (subclavian and axillary) which lies above the lower border of the pectoralis major tendon is innervated from a different source which has no possible relation to a cervical rib, and therefore this section of the main trunk remains always open and healthy in these cases.

If this hypothesis is tenable, it is possible to advance reasons for the small proportion of patients who manifest vascular complications, since all the following conditions are essential for the development of the complications: (1) Unusually intimate relationship of sympathetic fibres and rib; (2) Such depression of the shoulder as will lead to irritation—and not paralysis—of the sympathetic fibres in the lowest trunk; (3) The irritation must be of considerable duration.

It has long been known that the sensory and motor symptoms associated with cervical rib can be produced by a normal first rib, and we have published a series of these cases.[4] So far no case with vascular symptoms appears

to have been traced to a normal first rib, but there is no reason why this should not happen.

Of many cases of cervical rib with symptoms, few will show vascular disturbance, since few have the peculiar distribution of the sympathetic fibres which is essential to the development of vascular symptoms. Hence, in those much rarer cases in which the pressure is due to a normal first rib, the chances of unusual sympathetic distribution coinciding with the condition are of necessity remote. It is not unlikely that such a case may be reported in the future, and in the meantime it is worth while to remember that if a case presents vascular symptoms with no X-ray evidence of cervical rib, a normal first rib may none the less be the cause.

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OSTEOMA OF THE FRONTAL SINUS:

WITH PARTICULAR REFERENCE TO ITS INTRACRANIAL COMPLICATIONS, AND WITH THE REPORT OF A CASE.*

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ROCKEFELLER FELLOW, 1929–30.

Osteomata of the frontal sinus present many interesting problems, mainly on account of the effects which they produce by pressure upon neighbouring structures. Of primary interest to the rhinologist, they may extend by their characteristically slow and progressive growth into the domain of the ophthalmologist or the surgeon. In olden times, if small, they often passed unnoticed during life, only to be accidentally discovered by anatomists; if larger, they either became outwardly visible or produced symptoms and signs referable to the frontal sinus and nose, the eye, or the brain. The use of X rays has been of great help in establishing their presence, determining their extent, and appreciating the possible complications to which they may give rise. It is the importance of the intracranial complications which calls for emphasis.

A review of the literature concerning these interesting tumours gives much information as to their form and extent. This report will deal primarily with a large osteoma of the frontal sinus complicated by a ventricular pneumatocele and cerebrospinal-fluid rhinorrhœa. It will be recalled that in 1927 Dr. Cushing[1] gave a detailed report of four cases of orbito-ethmoidal osteomata having intracranial complications, and discussed in particular the treatment of these cases.

HISTORICAL INTRODUCTION.

Osteomata of the orbit have, according to Parsons,[2] been recorded since 1506, when Veiga first called attention to them, though the difference between primary bony tumours of the orbital cavity and those invading it secondarily could not then have been appreciated. The occurrence of bony tumours in connection with the frontal sinus has long been recognized both in domestic animals, in which they are comparatively common, and in man. Usually of small size, they occasionally attain truly alarming dimensions. This is small wonder if the osteoma became so large as to occupy one half of one hemisphere and to project considerably over the forehead, nose, and eye, as occurs in a specimen reported by Paget[3] which is now in the Museum at Cambridge. Yet another enormous tumour, occurring in an ox—the specimen of which is in the Museum of the Royal College of Surgeons of England (*Path. Spec.* No. 3216)—is described by Paget as "a great spheroidal mass of ivory

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measuring $8\frac{1}{2}$ inches in diameter and weighing upwards of 16 pounds". In veterinary literature some of these cases have been reported as 'ossified brains'.

As far back as 1799, Home[4] reported examples of tumours of the frontal sinus, and there are to be found illuminating pathological descriptions of frontal osteomata in the subsequent writings of Mackenzie,[5] Bouyer,[6] Rokitansky,[7] Weiss,[8] Cruveilhier,[9] Virchow,[10] and Hilton.[11] Efforts to remove these tumours were occasionally made, particularly by ophthalmic surgeons, but the operations were usually left incomplete and were attended with a high mortality. The difficulties appear to have been threefold: (1) The compact, hard, ivory nature of the tumours rendered them extremely resistant to any form of mechanical interference by saw or hammer and chisel; (2) The inability to determine by clinical examination alone the full extent of the mass; and (3) The extreme liability to a post-operative intracranial infection.

Paget[3] in 1851 reported a case occurring in a girl of 20 who suffered from exophthalmos due to an osseous growth in the upper and inner part of the orbit. It had been gradually increasing for three years, producing severe pain in the eye and side of the face. An attempted radical removal failed, and it was with great difficulty that an anterior portion was sawn off. The patient died shortly afterwards from generalized suppurative meningitis.

Roux[12] abandoned an attempt to remove a similar tumour in a young man, with the customary fatality from meningitis. The tumour was removed at autopsy by Nélaton and is now in the Val de Grâce Museum in Paris. Weiss[8] reported this case to the Société Anatomique in 1851, and Dolbeau[13] also describes and depicts it in his admirable memoirs on the exostoses of the frontal sinus written in 1871.

An unsuccessful attempt at removal by hammer and chisel of what was clinically a small tumour in a lad of 14 was made by Knapp[14] in 1861, with eventual death from meningitis in seven weeks. At autopsy this tumour was found to be much more extensive than was expected, measuring 59 by 55 by 54 mm., filling the left frontal sinus completely, the right partially, part of the ethmoidal cells, and the whole of the left and part of the right anterior cranial fossa.

There is an excellent example of a large osteoma of the frontal sinus to be found in the Warren Museum of the Harvard Medical School (*Path. Spec.* No. 1464) (*Figs.* 415–417). This occurred in a healthy young farmer who entered the Massachusetts General Hospital in 1864. There was a history of a severe blow on the forehead sustained while skating three years previously. The tumour measures 12·5 by 12 by 12·5 cm. Attempted removal, in the course of which four chisels were used with failure to penetrate the growth, was abandoned. Death in coma took place five weeks later, and at autopsy an abscess was found in the frontal lobe.

An attempt made by Jobert to remove, with a trephine, an 'exostosis' of the frontal sinus was abandoned on account of the extreme hardness of the growth. The patient died, and Dolbeau[13] refers to the specimen, which is in the Musée Dupuytren in Paris.

Arnold[15] in 1873 reported two cases, in one of which death occurred without operation. Simon operated on the other case, with the outcome of

post-operative meningitis and death, an abscess having formed in the left frontal lobe with rupture into the lateral ventricle. The dimensions of this

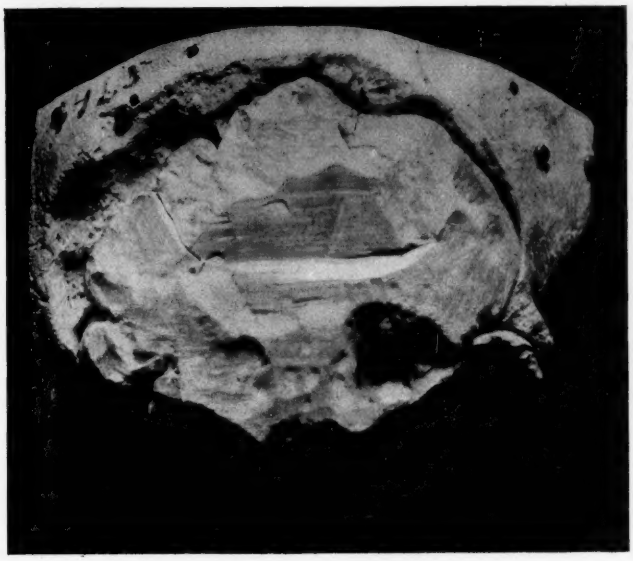


FIG. 415.—Large frontal-sinus osteoma, antero-posterior view. The flat surface in the centre was the result of attempted removal at operation. (× ¾.) (*Path. Spec. No.* 1464, *Warren Museum, Harvard Medical School.*)

FIG. 416.—The same, postero-anterior view. (× ¾.)

tumour were 9 cm. vertically, 7·5 cm. laterally, and 7 cm. antero-posteriorly, bearing a marked resemblance to the measurements of the tumour in the case to be subsequently described. Banga[16] also mentions a case operated

upon by Socin in 1871, with death from meningitis on the tenth day after operation.

Although two cases of spontaneous recovery following infection and suppuration with extrusion of the tumour are reported by Hilton[11] and Lucas,[17] the credit for the first successful operation, in 1867, belongs to Dolbeau,[13] whilst a second, with an equally good result, was carried out by Knapp[18] in 1880.

FIG. 417.—The same, lateral view, showing the limits of the anterior and posterior extensions. (× ¾.)

Up to and including 1880, surgery, as judged from reported cases in the literature had been attended by two cures, and in addition two cases had spontaneously cured themselves by sloughing—one of them after operative interference. This state of affairs undoubtedly influenced Berlin[19] when he wrote, in 1880, that enucleation of the eye should be resorted to when an osteoma of the frontal sinus has broken into the orbit, rather than any attempt to remove the tumour. Knapp,[18] in 1881, however, strongly advocated surgical removal, and stated that osteomata of the frontal sinus may and ought to be removed by subperiosteal enucleation, with careful avoidance of injury to the dura mater, as long as they are moderate in size.

However, towards the close of the last century, owing to the general adoption of Listerian principles, the prognosis following removal of osteomata of the frontal sinus underwent a radical change. An excellent account of the history of osteomata of the peri-orbital pneumatic cavities, with a report of the successful removal of two osteomata of the orbit, one originating in the frontal and the other in the ethmoidal air-cells, was written by Andrews[20] in 1887. In 1898 Tauber[21] reviewed the literature and found that 20 cases of frontal-sinus osteomata had been removed by operation, with 9 deaths—a mortality of 45 per cent. There is always present, then, a liability to infection, and, as in the prognosis of compound fractures of the skull, the important factor is whether the dura mater is intact or not—a point to which Knapp[18] drew attention. If, however, as in the example reported below, there is a free communication from the outside air, not only through the dura mater, but in addition through the cerebral substance into the ventricle, the case assumes far more serious proportions. In these circumstances the lesion can only be attacked with safety from above by way of the cranial chamber.

ETIOLOGY.

Frontal osteomata are more common in males than in females. This may be due to the fact that the sinus is on the average considerably larger

in the male, and therefore the seat of greater developmental activity; also it is more liable to external trauma. Fifty per cent of cases are said to occur during adolescence, and 80 per cent before the age of fifty years; that is, these tumours occur in young people, thereby resembling the occurrence of bony tumours elsewhere in the body. The second and third decades cover the period of life in which they are most likely to occur. These tumours of the frontal sinus are rare, but their relative frequency is difficult of estimation. Certainly before the advent of almost routine X-ray examination in cases of sinus trouble, several small 'latent' osteomata were missed. In 1881 Bornhaupt[22] reviewed the literature and came to the conclusion that the condition was more frequent than was formerly supposed. Knapp[23] in 1880 reported only 4 cases with intra-orbital extension in 56,000 patients; and in 1881[18] he reported 11 cases, his own single case, with cure following operation, being the first reported in America. Andrews[20] in 1887 found only 8 examples of bony growths of the orbit in nearly 430,000 ophthalmological patients. In 1905 Hucklenbroich[24] collected 54 cases of true frontal-sinus osteomata; in 1907 Gerber[25] reported 87; in 1918 Sewall[26] 93; in 1925 Lee[27] 100; in 1928 Harris[28] 117; in 1929 Browder[29] reported one case, to which may be added the case to be reported subsequently, bringing the number to 119. Kikuzi,[30] analysing 54 cases of accessory-sinus osteomata, found that 26 were of the frontal sinus; 11 ethmoidal; 10 antral; 5 of the sphenoid recess; and 2 of the nasal cavity. On the other hand, Gerber[25] gives the proportion of those arising in the ethmoid to those arising in the frontal sinus as 12 : 8. In 1918 Culbert[31] collected 215 cases of accessory-sinus osteomata reported since 1748, and stated that nearly half of them were of the frontal sinus. It is probable that frontal-sinus osteomata represent about 35 to 40 per cent of all accessory-sinus osteomata. The reason for this high figure, together with the causation of growth of these tumours, has been for a long time a vexed question and still remains unsettled. Many ingenious theories have been advanced in explanation, the most notable being:—

1. **Embryological or Developmental.**—It will be recalled that the frontal bone is ossified in membrane, whereas the ethmoid bone is ossified in cartilage. The frontal bone is the centre of marked developmental activity until well after puberty. Whilst traces only of the frontal sinuses are met with in the second year, they can be definitely distinguished at the seventh year, but do not attain complete development until about the sixteenth year. This state of affairs, coupled with the close proximity to the ethmoid bone, appears to favour the liability to occurrence of cartilaginous 'rests' in accordance with Cohnheim's original theory of the origin of new growths. In 1873 Arnold[15] advanced this cartilaginous 'rest' theory, pointing out, as did Cohnheim, that where different tissues come together there is a predisposition towards tumour growth. There is, however, much to be said against this theory. No evidence of cartilage is found in connection with these tumours, and they do not always arise from the ethmoidal bone. It was Rokitansky[7] who first supposed that these tumours had their origin in enchondromata. First, he thought the endosteum of the frontal sinus produced cartilage, forming enchondromata, which later became ossified, forming osteomata. Bornhaupt[22] in 1881 came to the conclusion that these tumours were of periosteal origin, although unable

to settle the question of their etiology. Sappey (quoted in Dolbeau's article[13]) lent support to the periosteal idea of their origin, stating that the periosteum in this region is peculiarly liable to ossification.

2. **Traumatic.**—Though a history of trauma, recent or remote, is often obtained, its direct relation to the osteoma is impossible of proof. Many writers, nevertheless, including Dubar,[32] de Taranto,[33] and Miodowski,[34] favour external trauma as an important etiological factor.

3. **Infective.**—Axenfeld[35] in 1904 noted the frequency with which catarrh of the mucous membrane of the sinus complicates the presence of these tumours. Hucklenbroich[24] stated that 37·8 per cent were definitely associated with sinusitis. Gerber[25] in 1907 expressed the opinion that they were the result of repeated infection, transient but more or less frequent; and Wray[36] in 1916 contended that sinusitis was the exciting cause in all osteomata of the accessory sinuses. He presented a specimen showing a bony excrescence which had not reached the stage of osteoma.

Syphilitic infection has been considered by some to be the etiological factor. Prior to the advent of the Wassermann test, syphilis was often quoted as the cause, but since then one rarely finds it given. Two cases reported by Culbert[31] and Mackenty[37] appear to be the only ones in which a positive Wassermann test was found.

As a matter of fact, it is not precisely known what the etiological factors actually are. So far as concerns infection, it is probable that the chronic irritation of the mucous membrane is a sequel of the lesion rather than its cause. What is more, infection rarely accompanies the osteomata of the accessory sinuses in their earlier stages.

PATHOLOGY.

Osteomata of the frontal sinus, as is almost invariably the case with bony tumours growing in connection with the cranial bones, are of the hard, ivory, compact variety—so-called 'exostosis eburnea'. They are connected to the bony wall of the sinus usually by a small pedicle, but occasionally they appear to have no point of attachment. Microscopically they show a concentric or irregular arrangement of the bone corpuscles, with a scantiness or absence of Haversian canals. Some specimens show a cancellous interior with a hard bony shell around it.

In 1856 Cruveilhier[9] gave the first description of any real value of these tumours under the title of 'corps osseux enkystés', believing that they originated in the diploë between the two tables of the skull, either forcing the inner and outer tables before them as a capsule or rupturing through them. In 1865 Virchow,[10] while giving credit to Cruveilhier for the idea that they arise in the diploë of the skull bones, took issue with the term 'corps osseux enkystés' and preferred not to separate them from the 'enostoses', a term which he introduced in contradistinction to the exostoses.

In 1907 Gerber[25] pointed out that these tumours present certain similarities with nasopharyngeal polypi, in that they are histologically benign but locally malignant—a feature referred to by Paget when describing the horrible complications to which they may give rise. This is further exemplified

by Bland-Sutton's[38] case, in which the following train of events occurred: (1) A swelling the size of a pea noticed at birth; (2) At 9 years the eye was totally destroyed; (3) At 25 the skin of the brow sloughed over; (4) At 35 the tumour fell out of the orbit, with spontaneous cure. Occasionally, also, these tumours show a liability to local recurrence after apparently complete removal. Thomas[39] reports such a case in a boy of 14, in which following an injury there was unusually rapid growth, so much so that within three months of the injury a dense osteoma had occurred involving all the left frontal sinus, extending into the orbit, and upward above the sinus and beyond the mid-line somewhat over the right orbit and into the right ethmoidal region. This was removed completely, and within nine months it had recurred. X-ray examination showed it to be even larger than previously. Three years after operation, radiograms showed that the tumour had grown back so extensively into the brain cavity as to be inoperable.

Barnhill[40] describes a case in a girl of 16 with an osteoma of the right frontal sinus of one year's standing which, as found at operation, grew from the region of the fronto-nasal duct. Ingersoll,[41] commenting on this case, points out the known tendency of these osteomata growing from the region of the fronto-nasal duct to recur, and as a result expresses a hesitancy to operate in such cases. Possibly when these tumours in young people show rapid growth and are attached to this region they are frankly sarcomatous.

Two additional points regarding the pathology to which scant, if any, attention has been called have emerged from the case reported below: (1) The presence of mucous membrane between tumour and normal bone serves to establish the line of cleavage between them; and (2) The mucous secretion shows a tendency to collect into cyst-like cavities called mucoceles which project through the dura mater into the brain substance.

CLINICAL ASPECTS.

Many osteomata of the frontal sinus remain small and pass undetected. It is characteristic of these tumours that they become steadily larger, so that sooner or later the majority produce subjective or objective evidence of their presence. They enlarge in a centrifugal manner, gradually destroying by pressure atrophy the limiting bony walls of the sinus in which they are contained. Whilst still confined within the greatly expanded sinus they manifest themselves by symptoms and signs resulting from inflammation and obstruction. In their onward march beyond the limits of the sinus they may extend anteriorly on to the forehead, across the mid-line through the medial septum into the opposite frontal sinus, or into the nasal, orbital, zygomatic, temporal, or cranial fossæ. Whichever direction they may take, they produce evidence of their invasion by pressure effects, causing obstruction, displacement, or destruction, coupled with the formation of mucoceles. For example, a frequent extension of these tumours is into the orbital cavity. By pressure they displace the eye downwards, forwards, and outwards, and interfere with the normal ocular movements, with consequent diplopia. Infection of the orbital cellular tissues is not uncommon. As a result of extrusion of the eye, the normal protective movements of the eyelids are impeded, with resulting

corneal ulceration and its sequelæ. But it is the effects of direct extension backwards into the cranial cavity that are of particular interest. It has long been known that these tumours may produce frontal-lobe symptoms by pressure thereon—namely, headache, dispositional changes, irritability, depression, mental dullness and apathy, together with the formation of large intracranial mucoceles. The case to be reported goes one stage farther, with rupture of a mucocele into the lateral ventricle and with subsequent pneumatocele.

CASE REPORT.

Osteoma of the frontal sinus with intracranial complications. Intracranial mucocele communicating with the ventricle, causing cerebrospinal rhinorrhœa, and radiographically demonstrable filling of the ventricular system with air. Removal of tumour in two sessions. Repair of cerebrospinal fistulæ at a third. Recovery.

T. A. T. (Surgical No. 35928), male, age 36, was admitted to the Peter Bent Brigham Hospital on March 5, 1930, on the advice of Dr. Hanrahan, of Rutland, Vermont, complaining of periodic 'filling up' at the root of the nose causing dull headache, followed and relieved by a watery discharge from the nose.

HISTORY.—The patient was a healthy, vigorous man, an electrical supervisor by occupation, with no history of any preceding illness which might conceivably

FIGS. 418, 419.—The patient on admission to hospital.

have had any bearing upon the present condition. There was no history of difficulty or injury at birth, of trauma, or syphilitic infection. He had been married for fifteen years, there being five children, all living and well, whose ages ranged from 14 to 6 years.

He had consulted Dr. Cushing in 1913 on the recommendation of Dr. W. P. Clough, of Sutton, New Hampshire, because of a 'hard projecting lump' on his forehead which had first been noticed by his mother six years previously and which was slowly increasing in size. After examination, including an X-ray study, a

diagnosis of osteoma of the frontal sinus was made. An operation was advised but declined.

In the seventeen years' interval the tumour did not undergo any marked outward change. There had been a predisposition to attacks of 'grippe' at intervals during the winter months which caused him undue trouble, leaving him very weak and easily fatigued afterwards. During the last twelve months a subjective sensation of periodic 'filling up' behind the root of the nose associated with a dull headache had occurred, to be followed by the discharge of a watery fluid drop by drop from the left nostril only, with relief of both the discomfort and headache. This post-nasal discomfort had occasioned extreme irritability of the nose, causing the patient to get into the habit of blowing his nose violently and frequently in an attempt to rid himself of his discomfort. The headache was generalized, but maximal bitemporally. The patient had also experienced, when the 'filling up process was incomplete', as he thought—probably correctly—a subjective sensation of splashing within the head. The nasal discharge was watery, clear, colourless, odourless, and tasteless.

In January, 1930, he had a particularly severe attack of 'grippe' in which quite suddenly he became semiconscious, extremely drowsy, and stuporous. His memory of this attack is entirely lacking, but his wife states that he remained in this condition for about thirty-six hours, gradually recovering normality except for noticeable increase in irritability. It was this attack that led to his re-entry into the hospital.

On Examination.—Physical examination revealed the presence of a stony-hard bony swelling on the forehead, rather more to the left than to the right of the mid-line, between the root of the nose and the hair line (*Figs.* 418, 419). It was not attached to the skin, which was normal and freely mobile over it, but it was fixed deeply to bone. Roughly circular in outline, it measured approximately 6 cm. in diameter, with a maximum elevation of 2 cm., gradually shelving off to the general level of the forehead at its margin. The surface appeared uniformly hard and slightly uneven. Nasal examination was negative. The fundi and visual fields were normal.

X-ray Examination (*Figs.* 420, 421).—This was made by Dr. Sosman, who reported as follows: "Right stereo antero-posterior and postero-anterior films of the skull show a thin vault with an unusually dense cauliflower mass filling the frontal sinuses and apparently breaking through both anteriorly and posteriorly. This has the typical appearance of an osteoma, probably arising in the frontal sinus. It measures 6·5 cm. vertically, 7 cm. laterally, and 6 cm. antero-posteriorly. There are slight signs of increased intracranial pressure, and also several collections of air in the left ventricle, the entire left temporal horn being well filled, indicating a communication between it and the frontal sinus. The sella turcica is normal and the mastoids are clear."

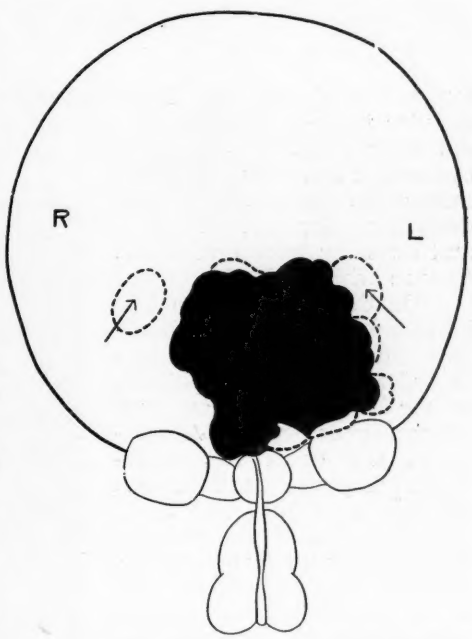


Fig. 420.—Diagram of postero-anterior radiogram on admission, showing: (1) The cumulus-like outline of the tumour mass, bounded in areas by a rim of air in the tumour-expanded sinus; (2) The air-containing occipital horns of the ventricles (marked by arrows).

Diagnosis.—A diagnosis was made of an osteoma of the frontal sinus complicated by an intracranial mucocele communicating with the ventricular system, and an operation was recommended.

Pneumatocele ?

FIRST OPERATION (March 16).—Novocain-adrenalin infiltration anæsthesia. Left transfrontal approach. Exposure of a large eburnated osteoma. Gradual

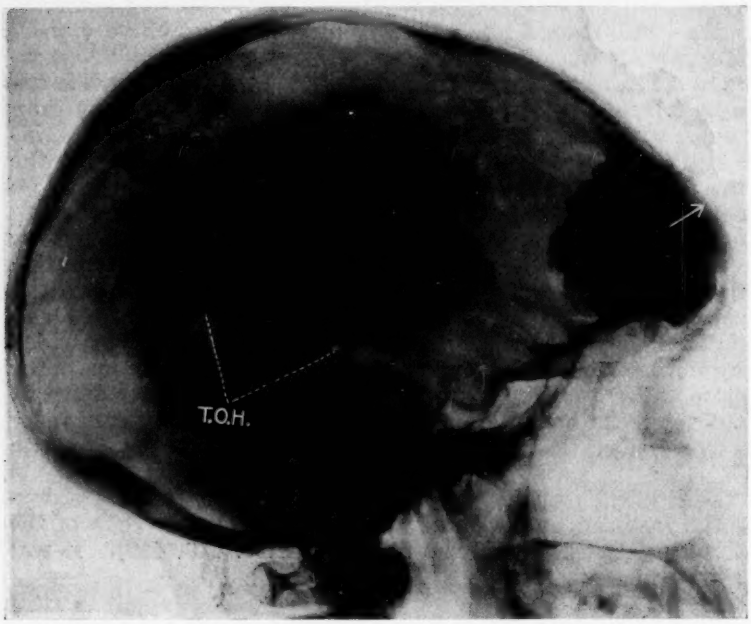


FIG. 421.—Left lateral skiagram on admission, showing: (1) The shadow of the tumour in profile with evident extension through the anterior wall (marked by arrow) of the sinus; (2) The air accumulated in the temporo-occipital horn of the right ventricle (T.O.H.).

excavation of osteoma. Piecemeal dislodgement of main portion of the extremely nodular tumour from greatly expanded frontal sinus. Accidental opening of the ethmoidal cells. Disclosure of a large multicystic mucocele, of which three or four cysts came away with the chief mass of the tumour, completely denuding collapsed frontal lobe and exposing lateral ventricle. Closure with drainage.

Dr. Cushing had hoped to be able to turn down a bone-flap from over the tumour in order to spare the patient, so far as possible, from any subsequent deformity. Accordingly, the usual left transfrontal flap was outlined and the first burr hole was made in the region of the glabella. Immediately bony tumour was encountered, confirming the X-ray evidence that the anterior wall of the frontal sinus was in great part deficient over the tumour, having been destroyed by pressure atrophy. A succession of burr holes were then made into the tumour, and by degrees many nodules of the growth were freed and rocked out of their bed. When in this

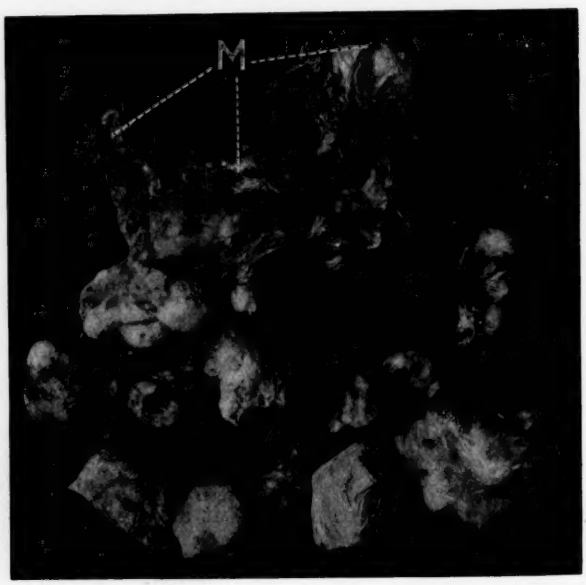


FIG. 422.—Showing mucous-membrane-lined fragments of the osteoma removed at the first operation (March 17, 1930). Note mucoceles (M) in upper part of field.

process the posterior limit of the tumour was finally reached, no trace of the expanded posterior bony wall of the sinus or of the dura mater was visible. Instead, there was a large multilocular cystic mucocele, of which three or four cysts came away attached to nodules of the tumour, with some leakage of purulent-looking contents. In view of this leakage it was considered advisable to withhold further interference with remaining portions of the tumour or with the large mucocele which appeared to extend into the open lateral ventricle. The wound was closed, with guttapercha tissue drainage at each angle of the incision.

The fragments of the osteoma are shown in *Fig.* 422 just as they were removed. Hanging from three or four nodules can be seen the remains of mucous membrane which had formed part of the huge multicystic mucocele which extended so far into the brain as to project directly into the ventricle.

Bacteriological examination of the contents of the mucocele showed them to be sterile.

Post-operative Course.—Cerebrospinal rhinorrhœa from the left nostril commenced almost immediately after operation, and persisted. Daily tappings through the centre of the flap and bony defect were carried out, drawing off approximately 40 to 50 c.c. of blood-stained fluid per diem, with disappearance of all tension of the flap. The drains, being of little value, were removed on the second day. A rise of temperature to 101° rectally with an associated white-cell count of 17,500 occurred within twelve hours of the operation. This fever, after rising as high as 102·8° rectally on the third day after operation, gradually subsided, as did the leucocytosis, so that on the eighth day the chart was normal in all respects. At this time (March 24) X-ray examination was repeated, showing that about two-thirds of the osteoma had been removed, there still remaining a good-sized fragment in the right frontal sinus (*Figs.* 423, 424). In addition there was a loose fragment in the cranial cavity and also very considerable amounts of air in the ventricles.

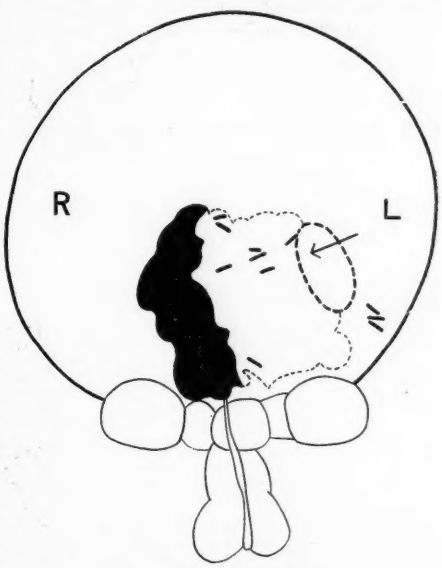


FIG. 423.—Diagram of postero-anterior radiogram (March 24, 1930), seven days after the first operation, showing: (1) The residual portion of the tumour to the right of the mid-line; (2) The air in the occipital horn of the left ventricle (marked by arrow).

Valuable information had been obtained as a result of this first operation. Although in the main the tumour was of bony hardness throughout, certain areas were not quite so hard, and yielded more easily when attempts to remove them were made. In addition, the demarcation lines between normal bone and tumour noted in the radiograms were clearly understood, being marked by the presence of mucous membrane. On the ninth day after operation it was therefore decided to attempt removal of the remainder of the tumour.

SECOND OPERATION (March 26).—Reflection of old flap. Piecemeal removal of remainder of tumour. Occlusion of ethmoidal communication by muscle implant. Attempt to remove posterior wall of mucocele projecting deeply into the frontal lobe and ventricle abandoned. Closure with drainage.

It was possible, fortunately, to preserve the paper-thin supra-orbital bony ridge, thereby reducing the inevitable subsequent deformity. The remaining fragments of the tumour (*Fig.* 425), attacked by burrs, rongeurs, and periosteal elevators, were finally rocked out of their bed. The region of the blow-hole was located by a device which would not have been possible had the patient been under inhalation narcosis; the bottom of the huge cavity was covered with a layer of saline solution and the patient asked to hold his nose and to exhale forcibly. Air bubbled up

through the fluid, making it easy to locate the point of communication into the nose. A flap of mucous membrane was turned back and a muscle stamp implanted under its edges.

Post-operative Course.—This was in the main similar to that following the first operation, except that it did not occasion so much apprehension in view of the

FIG. 424.—Right lateral skiagram (March 24, 1930), showing the residual tumour with free fragment (F), and with air at A in free space of former bed of tumour, and at B in anterior horn of left ventricle, into which mucocele (M) projected.

experience already obtained. After removal of the drain on the third day daily tappings were carried out, approximately 50 c.c. of much clearer fluid than formerly being removed. X-ray examination carried out on the sixth day (April 1) showed that the osteoma had been completely removed (*Figs.* 426, 427). There was no air in the ventricle.

On the ninth day the patient was perfectly well. He was up in a wheel-chair, temperature, pulse, respiration, and white-cell count being normal, and the wound completely healed, with no bulging of the flap. On the following day, however, cerebrospinal rhinorrhœa recommenced, in no way due to any misbehaviour on the patient's part. He had most strictly adhered to instructions to avoid violent movements of the head, blowing his nose, or sneezing. Most disappointingly, however, the discharge continued and increased in amount. On April 8, X-ray examination showed an abundance of air in the ventricle, one irregular collection being situated just beneath the operative area, probably in the mucocele, whilst another regular collection, estimated at about 15 to 20 c.c., clearly outlined the ventricular system.

In the hope that the discharge of

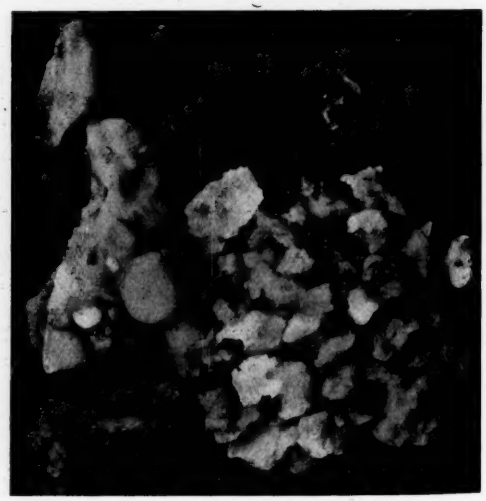


FIG. 425.—Fragments of the osteoma removed at the second operation (March 26, 1930).

cerebrospinal fluid would cease spontaneously, further operative interference was postponed, but no improvement occurred. Further X-ray study carried out on April 22 (*Fig.* 428) showed exactly the same amount of air in the ventricles as was seen on April 8, and further operative interference was decided upon, because the patient still had the condition for which he was operated upon originally—namely, cerebrospinal rhinorrhœa—although the frontal osteoma itself had been removed.

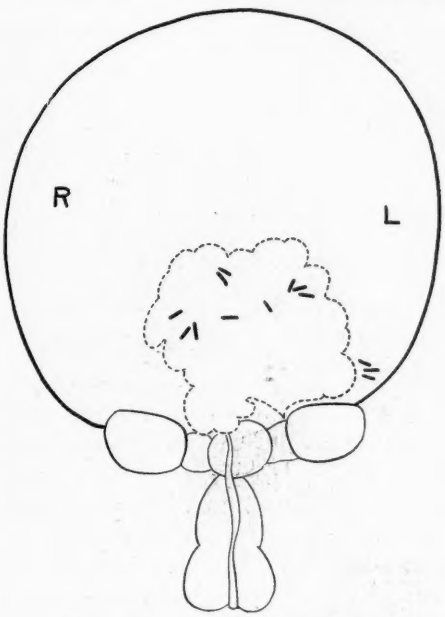


FIG. 426.—Diagram of postero-anterior radiogram, six days after second operation, showing complete removal of tumour. No air in ventricles.

THIRD OPERATION (April 28).—Exploration disclosed a huge, perfectly dry mucous-membrane-lined cavity with two openings, one into the right nasal cavity and the other into the left. Implants of fascia taken from patient's leg placed over both openings under mucous membrane flap.

The cavity, completely lined with apparently normal-looking mucous membrane, was of exactly the same size as seen at the former operation. In the base of the cavity leading apparently down into the nares, where the previous muscle implant had been made, there was a hole which admitted the tip of the little finger. The muscle implant probably had shrunk. A few drops of fluid irrigated through this hole ran directly into the nasopharynx and were swallowed. The mucous membrane was reflected from around this opening, a fascial stamp about 2 cm. in diameter was used to cover up the hole, and the edges of the mucous membrane were carefully placed

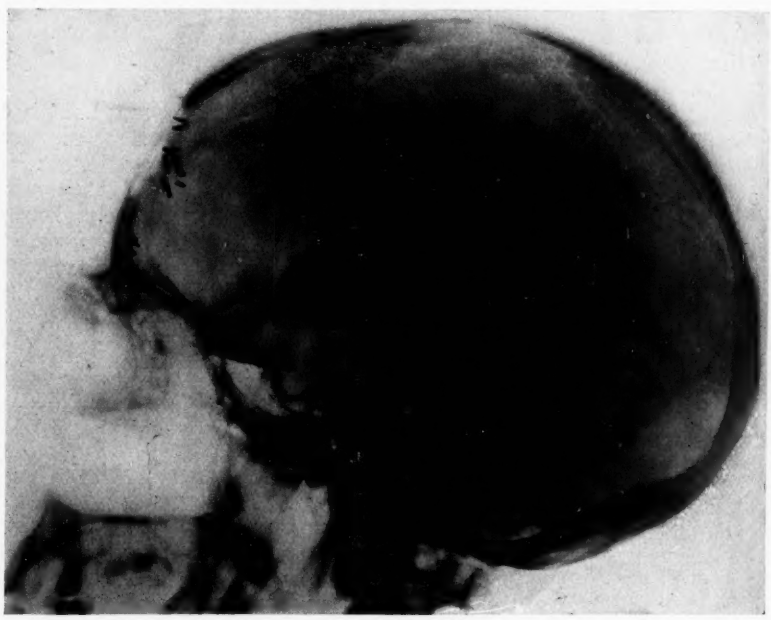


FIG. 427.—Right lateral skiagram, six days after second operation, showing complete removal of tumour and absence of air in ventricles.

back over it. On asking the patient to hold his nose and blow, it could be seen that the fascial implant elevated but remained *in situ*. When carrying out this

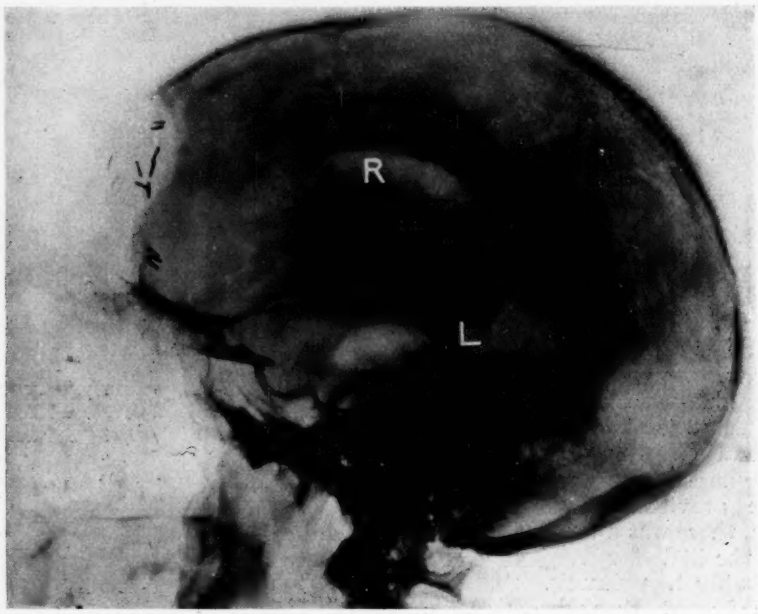


FIG. 428.—Condition found on April 22, 1930, after re-establishment of rhinorrhœa showing air in both right (R) and left (L) ventricles.

procedure it was also noted that a squeak could be heard which the patient said he had heard previously on occasion. This was found to originate in a very small

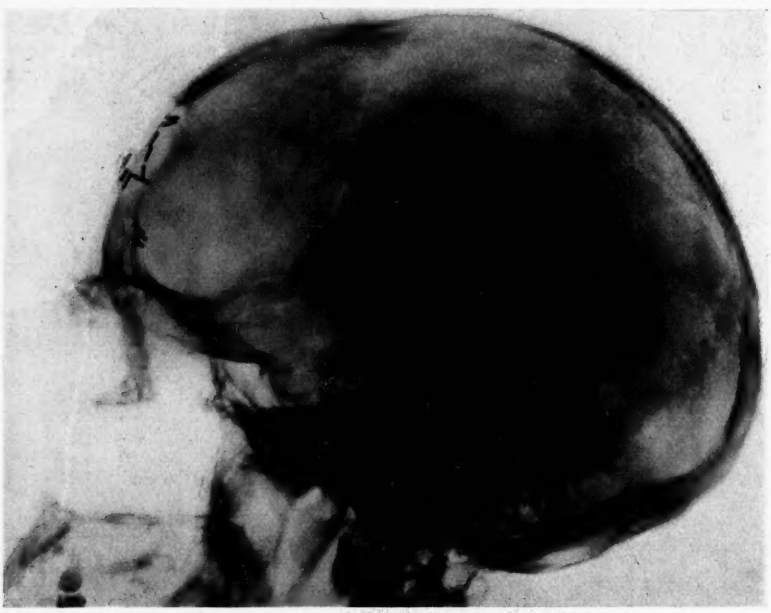
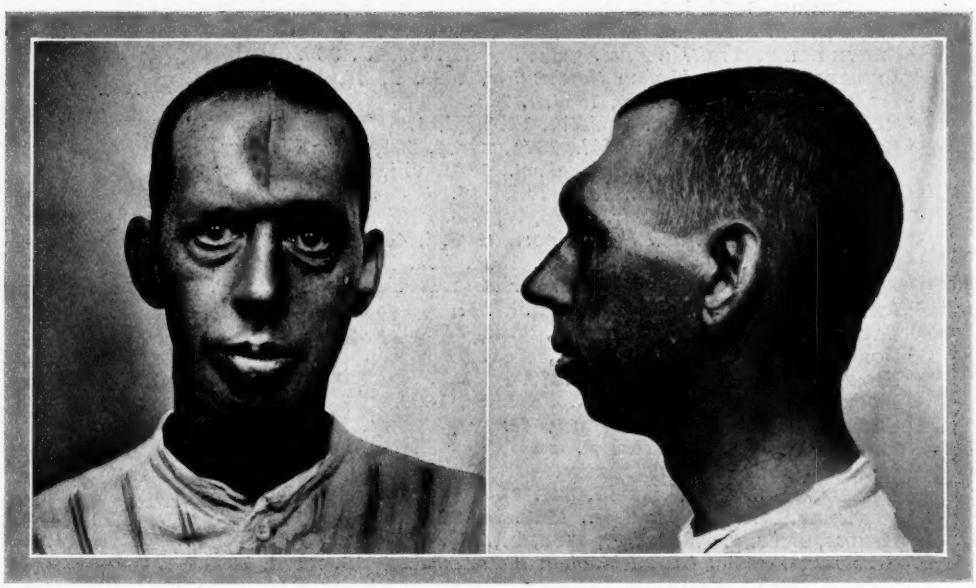


FIG. 429.—Right lateral radiogram taken on May 5, 1930, after the third operation, showing almost complete disappearance of air from the ventricles.

communication with the right anterior ethmoidal air-cells. Accordingly the mucous membrane was reflected therefrom, a fascial stamp applied, and the mucous membrane flaps were replaced over it. It was decided not to fill the cavity with salt solution but to leave it dry. Closure without drainage.

Post-operative Course.—The immediate post-operative condition was satisfactory, but on the third day the patient became extremely drowsy and could only be aroused with difficulty. The temperature had risen to 102°, the white-cell count being 10,400, and he was obviously mentally upset and very stuporous. On the fourth day, however, he commenced to improve, so much so that he was up in a wheel-chair on the eleventh day with no sign of cerebrospinal rhinorrhœa. X-ray examination on May 5 (*Fig.* 429) showed almost complete disappearance of air from the ventricles. There was no protrusion at the site of operation. His final condition can best be seen in the photographs taken on May 9 (*Figs.* 430, 431). X-ray



FIGS. 430, 431.—Patient on discharge from hospital, May 9, 1930.

examination carried out on this date showed that all the air inside the skull had been absorbed. He was discharged from hospital cured on May 15.

Three and a half months later, on Aug. 27, he returned for examination. He had been perfectly well, without any recurrence of cerebrospinal-fluid rhinorrhœa, had gained forty pounds in weight, and was working full time as an electrical supervisor. X-ray examination on this date showed no sign of any air inside the skull.

SUMMARY.

An historical survey of the subject of osteomata of the perinasal sinuses is given in association with a report of a large frontal osteoma complicated by multiple mucoceles, one of which communicated with the lateral ventricle, causing a cerebrospinal rhinorrhœa and a ventricular pneumatocele. The bony tumour was removed in two stages, and a third was necessary to close two cerebrospinal fistulæ by means of fascial implants.

I wish to express my indebtedness to Dr. Cushing for kind permission to publish the case, and also for his helpful criticisms and advice.

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TRANSPLANTATION OF AN EXTERNAL BILIARY FISTULOUS TRACT INTO THE DUODENUM.

By GEORGE E. WAUGH,
SENIOR SURGEON TO HAMPSTEAD GENERAL HOSPITAL.

Recently Waltman Walters[1] reported his own fifth case of transplantation of an external biliary fistula into the stomach or duodenum. At the end of his description he writes, "In the literature the total number of cases of transplantation of these fistulas, including the 5 which I have reported, is 12." In view of the rather surprisingly small number of cases that have been put on record, it may be worth while to give the details of one more case of an external biliary fistula which was transplanted successfully into the duodenum by the writer in February, 1929. Although the patient is 74 years old, he is still at the date of writing (October, 1930) in excellent health.

Many plastic operations upon the bile-ducts are described in authoritative text-books of surgery such as Moynihan's *Abdominal Operations*, *The Art and Science of Surgery* by Mitchiner and Romanis, and *Surgical Operations* by Rowlands and Turner, but this particular variety seems to have escaped attention. Under the heading "External Biliary Fistula" the possible cause, such as retained calculus or stenosis of the common duct, is fully discussed, together with details of operative procedures which must be modified according to the condition actually found at operation; but transplantation of the whole fistulous tract is not mentioned. Perhaps the necessity of doing so is as uncommon as would appear from Walters's statement; or under certain pathological conditions it is so obviously the only thing that can be done that operators have not considered it worthy of record.

One aspect of this condition, however, seems to require special emphasis, and that is the necessity of preserving the whole of the fistulous tract intact until a preliminary dissection has revealed the exact pathological state of the biliary apparatus. In this particular case the history of the previous operation seemed to suggest that a portion of the gall-bladder combined with some obstruction of the common duct would be found; and with this pre-fixed idea it was more by good fortune than design that the whole tract was preserved in its integrity. If it had been cut across at any earlier stage of the operation to facilitate an arduous and difficult dissection, under the impression that parts of the gall-bladder and cystic duct were contained therein, the result would have been disastrous. Only when all the structures in the matted gastro-hepatic omentum had been dissected clean was it possible to realize that the whole of the common duct, common hepatic duct, cystic duct, and gall-bladder had disappeared, and that the now isolated tract led from a lateral opening in the right hepatic duct to the surface of the body (*see Fig.* 433). Walters in one of his cases made an artificial

external fistula by draining an " intra-hepatic duct to the surface ", and two months later transplanted successfully the artificial tract into the stomach. The reason for doing this was that all traces of the normal bile-ducts had disappeared following upon a cholecystectomy done by some other surgeon, and the patient had suffered from complete obstructive jaundice for one month before coming under Walters's care.

HISTORY.—W. M. G. G., male, age 73 years, was first seen in February, 1929, in consultation with Dr. W. Jagger and Dr. Evelyn Rich. It was then stated that one year previously an emergency operation had been performed upon his gall-bladder and that the wound had never healed. The few details that were obtainable about the operation indicated that a gangrenous portion of the gall-bladder had been excised and a tube inserted into the remainder. A complete biliary fistula had formed at the site of the drainage-tube (*Fig.* 432), and apparently the whole of the bile that was formed passed on to the surface of the body. The stools were clay-coloured; the urine contained only a faint trace of pigment; and the copious output of bile on the surface soaked through enormous dressings of wool three times daily. He had undergone an operation for the removal of his prostate ten months previously to the gall-bladder operation, and this had left him with permanent incontinence of urine. With two external fistulas his plight was very miserable, and although he was a high operative risk it was decided to attempt the closure of the biliary fistula. In addition to the handicap of his age he had emphysema and a slight tendency to bronchitis.

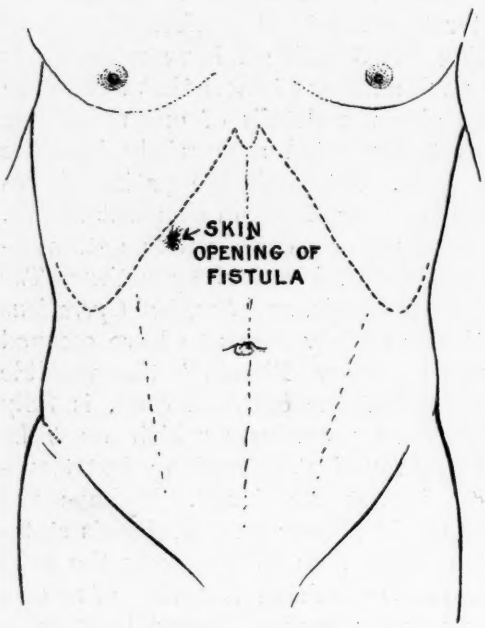

FIG. 432.—Showing site of external biliary fistula.

OPERATION (Feb. 25, 1929).—Gas and oxygen were administered by Dr. E. A. Seymour, and the lower six intercostal nerves on both sides were infiltrated with 1 per cent solution of novocain and adrenalin just anterior to the angles of the ribs. The opening of the abdominal cavity, after having turned the upper two-thirds of the right rectus outwards, was a matter of extreme difficulty on account of dense adhesions matting intestines to one another and to the anterior abdominal wall. After a prolonged dissection, during which the fistulous tract was isolated, the site of the gastro-hepatic omentum was defined ultimately. The foramen of Winslow was closed by stout fibrous tissue, and the whole of the gastro-hepatic omentum in the immediate neighbourhood was an equally stout fibrous mass from which the inner end of the fistulous tract emerged just below the transverse fissure of the liver. This mass was opened up cautiously from the upper border of the

duodenum to the level of the tract, and the portal vein and hepatic artery were stripped clean. The tract thus defined was then seen to emerge from the outer margin of the right hepatic duct (*Fig.* 433), whilst below that point all other portions of the biliary apparatus were absent. The surface opening of the fistula was detached from the skin, and, after mobilizing the second part of the duodenum, an easy anastomosis was made between the two through an incision in the duodenum, with two layers of continuous catgut sutures applied in the manner of an ordinary gastrojejunostomy operation

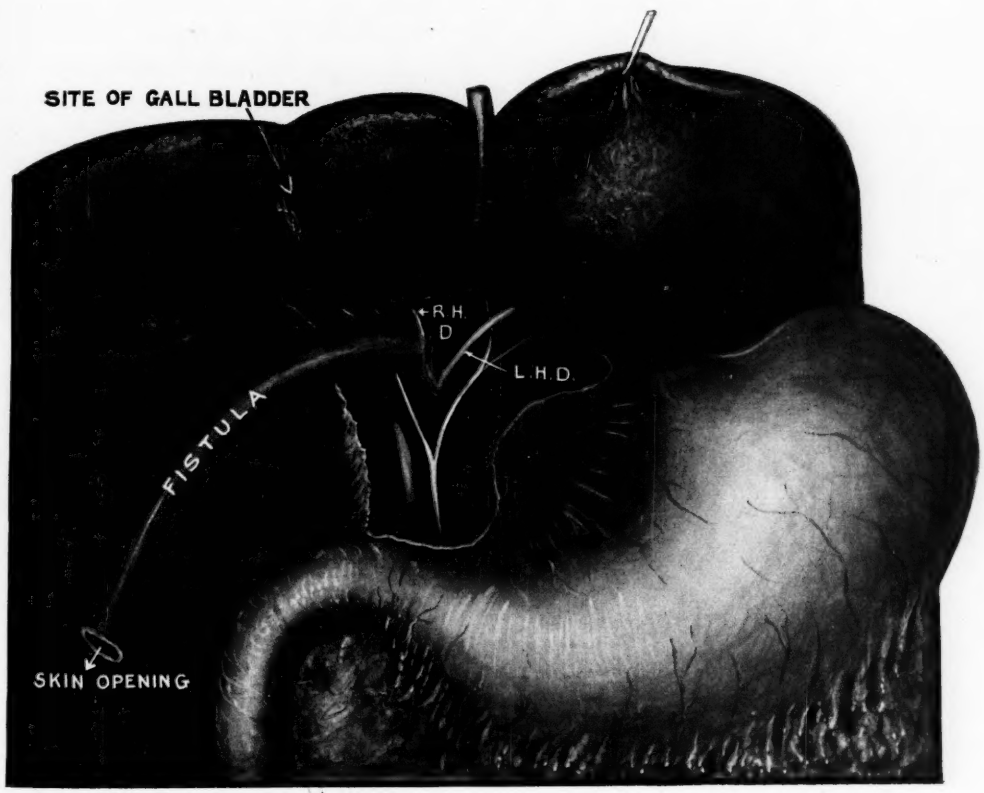

FIG. 433.—The liver has been turned upwards and the area of dissection in the gastro-hepatic omentum is shown outlined by a white line. The relative sizes of the fistulous tract and the hepatic ducts have been drawn to scale.

(*Fig.* 434). Omentum was stitched to the site of the anastomosis and a tube inserted down to it through the old fistulous opening on the skin. This proved to be superfluous and was removed at the end of forty-eight hours. The total duration of anæsthesia was two and a half hours, and $2\frac{3}{4}$ oz. of ether were administered at one stage to improve relaxation. The pulse-rate was only 80 at the end of the operation, and had fallen to its normal rate of 68 on the following day.

SUBSEQUENT PROGRESS.—The convalescence was remarkably smooth. For a full period of seventy-two hours the patient was allowed nothing

except abundant subcutaneous infusions of saline solution, 20 per cent glucose and saline per rectum, and hypodermic injections of heroin to ensure rest and sleep. At the end of this period raw eggs beaten up with glucose and brandy were given by mouth. The bowels acted of their own accord on the fifth day, and some pigment was present in the stool. Subsequent motions were normal in colour and the urine became a deeper yellow. He went home at the end of four weeks from the day of operation.

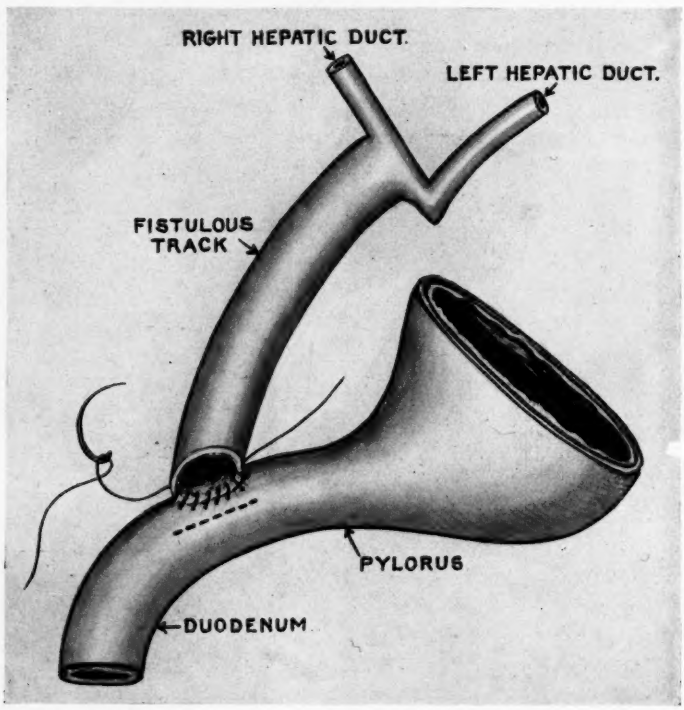

FIG. 434.—The method of anastomosis is shown in the first stage; the dotted line on the duodenum marks the line of incision into it necessary to complete the second stage.

On Oct. 5, 1930, Dr. E. Rich reports, "G. G. is wonderfully well except for his incontinence of urine".

The illustrations were drawn by Mr. S. A. Sewell from rough sketches of my own made at the time of operation.

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UNUSUAL COMPLICATION ARISING DURING OPERATION FOR A LARGE HYDATID CYST OF THE LIVER.

By JAMES A. JENKINS, Dunedin, N.Z.

The following case appears to be worth recording, as I am unable to find in the literature available any report of a similar complication arising during operation.

The patient, a male, age 43, married, was admitted on May 14, 1930, complaining of epigastric pain and jaundice of ten days' duration.

Previous History.—No previous illnesses. Does heavy manual work. Habits satisfactory. Nothing of importance in the family history.

Present Illness.—When at work ten days previously, he was suddenly seized with severe epigastric pain. It gradually eased off and he carried on with his work for that day. He took salts on arrival at his home and vomited shortly after. The next day he was jaundiced. He remained at home for a few days, and then returned to work, but still felt ill. The jaundice progressed, and on the day before admission he had another attack of severe pain which radiated to the back. He was sent into hospital with a diagnosis of cholecystitis.

On Admission.—Temperature 100·5°, pulse 75, respirations 25. He was deeply jaundiced, the tongue was coated, and he looked a rather sick man. The edge of the liver could not be felt, but there was an ill-defined rounded fullness of the right lobe, extending below the right costal margin for about two inches on deep respiration. Bile was present in the urine, and the stool was clay-coloured. Other systems revealed no abnormality worth recording. X rays showed the right dome of the diaphragm to be much raised, and that general enlargement of the liver was present. The stomach was shown by barium meal to be pushed over to the left. Tests: Kahn and Wassermann, negative; Kolmer quantitive (hydatid), + + + + +; hydatid complement fixation, strongly positive; Casoni, strongly positive; van den Bergh—qualitative, immediate direct; quantitative, 5·5 units; T.N.P.N., 34 mgrm. per 100 c.c.

Calcium chloride was given intravenously, and blood coagulation time on the day of operation was normal. His temperature during the six days he was in the medical ward prior to operation ranged from 99·9° to 100°. His jaundice progressed, and the stools remained clay-coloured throughout. He was transferred for operation on May 20 with the diagnosis of hydatid of the liver, and we considered daughter cysts in the common bile-duct to be the most likely cause of his jaundice.

Operation.—Anæsthetic: ether combined with local nerve-block of abdominal wall. Right paramedian incision with reflection outwards of the right rectus muscle. The right lobe of the liver was somewhat enlarged and

the normal contour was lost. The omentum was adherent to the diaphragmatic surface of the liver. On palpation it felt very firm, tense, and unyielding. No fluctuation was present. On the diaphragmatic surface of the liver there was considerable fibrous change. The left lobe had undergone marked hypertrophy, presumably of a compensatory nature. The gall-bladder was tense and distended. Examination of the region of the portal fissure and common bile-duct showed that the large cyst present was not responsible for the obstruction of the common bile-duct. The head of the pancreas felt normal. No attempt was made to explore the common bile-duct, as the patient was too ill to permit of any non-essential prolongation of the operation. The enlarged liver made the common bile-duct very difficult of access. The original diagnosis of daughter cyst in the common bile-duct was considered highly probable, and cholecystostomy was performed with the view to removal of the daughter cyst at a second stage.

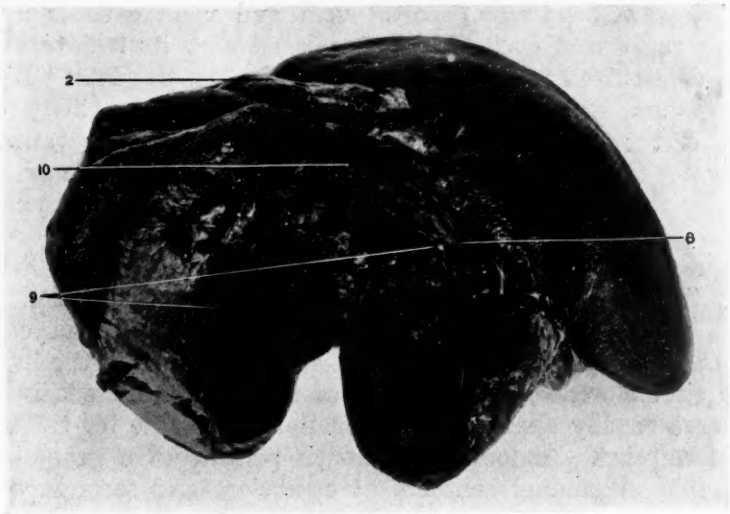
The cartilaginous costal margin was rapidly resected, and the presenting surface of the liver sutured to the parietal wound. This was readily done in view of the fibrous change in this part of the liver. There was no hæmorrhage. The lower abdominal wound was closed up to this point, thus isolating the field of potential infection. An area of about 3 in. by 2 in. of presenting cyst was packed off, the cyst tapped and formalinized, and then incised. About a third of an inch of tough fibrosed liver (pericyst) had to be cut through before entering the cyst. Daughter cysts came away freely, and their expulsion was aided by gentle irrigation through a $\frac{3}{4}$-in. glass tube. In all, two to three quarts of cyst and fluid were expelled without any manipulation of the interior of the cyst other than irrigation, when venous oozing commenced. At first it was not very severe, but in a few minutes it assumed alarming proportions. It welled up from the depth of the cyst, and in the course of two or three minutes the patient's condition changed from one of comparative safety to one causing the gravest concern.

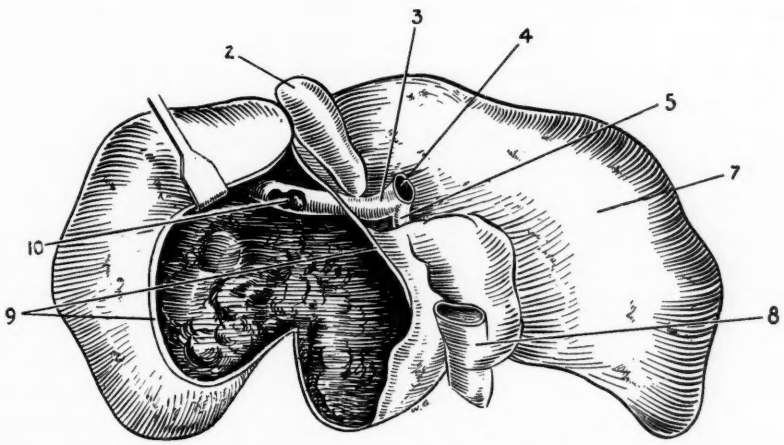
The site and source of the hæmorrhage was not known. I realized that a large vein had ruptured into the cyst cavity after the tension had been reduced, but whether a branch of the portal vein or vena cava I did not know. The abdomen had been closed prior to opening the cyst, hydatid daughter cysts were presenting every second or so, and at first I was loath to re-open the abdomen and compress the portal vein and hepatic artery in the lesser omentum. At the end of about two minutes the patient's condition was such that this procedure would probably have precipitated death on the table.

The cyst cavity was filled up with saline to which was added a little flavine. The opening into the cyst was very tightly plugged with gauze (tight suturing would have been much better), the wound packed, and the patient returned to bed. One pint of blood, two of intravenous saline, followed by a further pint of blood, were given. Death occurred a few hours later from continued hæmorrhage into the cyst cavity.

POST-MORTEM.—Autopsy revealed the source of the hæmorrhage. The right branch of the portal vein, immediately after entering the liver, passed through the pericyst (fibrous condensation of tissue surrounding the hydatid), and its wall was completely eroded (*Figs.* 435, 436). The index finger could

be passed from the cavity into the vein. Some old thrombus was present at this site. The whole of the right lobe of the liver was destroyed, being expanded over the cyst. The left lobe was greatly hypertrophied. In the common bile-duct near the ampulla a daughter cyst was tightly lodged.





FIGS. 435, 436.—Under surface of liver, showing right lobe largely converted into a cyst with dense leathery pericyst. Inside the cyst are seen daughter cysts and membranes of the mother cyst, and, embedded in the upper part of the anterior wall, the right branch of the portal vein is seen, with a large erosion which permitted the fatal hæmorrhage. The left lobe shows marked compensatory hypertrophy. 2, Gall-bladder; 3, Right branch of portal vein; 4, Portal vein; 5, Left branch of portal vein; 7, Hypertrophied left lobe of liver; 8, Vena cava; 9, Divided wall of cyst; 10, Right branch of portal vein passing through the pericyst, showing erosion.

COMMENTARY.

Biliary colic and jaundice of an obstructive type due to daughter cysts or débris in the ducts have been so frequently reported in Australasian publications that discussion of this aspect of the case, though of interest, does not differ from many already published. Its frequency is such that a

provisional diagnosis of daughter cyst in the common bile-duct was made prior to operation.

Profuse hæmorrhage may occur from large veins should it be necessary to cut through liver tissue, and also if misplaced attempts are made to remove calcareous pericyst. That danger is always present in large cysts is obvious when the close association of portal vein and vena cava is appreciated. Spontaneous rupture of cysts into the vena cava or its tributaries accounts for sudden death from parasitic emboli or anaphylaxis (Pitts,[1] Bird[2]). The reverse procedure, or rupture of an eroded vein into the cavity within the pericyst, after the support of the hydatid membrane is withdrawn, is almost unique. Syme[3] reported a terrific hæmorrhage from an erosion of the inferior vena cava by the cyst. His case is the only one I can find reported in the literature in any way parallel to the one here discussed.

Procedures adopted in the treatment of large cysts of the liver vary in detail, but the two essentials are: (1) To avoid contamination of wound, peritoneum, pleura, etc.; (2) To eradicate the endocyst, ectocyst, and cyst contents. A large cyst usually presents near the surface of the liver at some part of its circumference, but the area of thinned liver tissue is very often not in an area readily approached surgically, or suitable for treatment after the cyst is emptied. Abdominal approach permits of a general survey of liver and other abdominal contents at operation, and secondary cysts and other complications are more readily dealt with; but if the cyst is presenting under the right cupola of the diaphragm, approach after rib resection is most commonly adopted. Whether infected with pyogenic organisms or not, scrupulous attention must be paid to isolation of the field of operation before the cyst is opened. A two-stage operation, to permit of sealing off, is for this reason often to be recommended. After the cyst is exposed and the field effectively sealed and packed off, it is formalinized in order to kill scolices. To do this the cyst is aspirated and the contents replaced with 1 per cent formalin. That formalin is a very destructive agent on the host's tissues is well known, and should it get in contact with pericyst outside the cyst membrane and remain there for any length of time, gross destruction of tissue may occur later. In a cyst packed with daughter cysts the likelihood of efficient sterilization is not great whatever method is adopted. Dew[4] recommends the injection of a small quantity of pure formalin so as to make a final solution of 1 per cent. The required amount is hard to estimate in any individual case. After removal of cyst contents, the membranes of the mother cyst usually separate spontaneously. Gentle irrigation of the cavity with saline washes out all formalin and brings fresh daughter cysts to view. Other cysts may then be seen bulging into the one already dealt with.

All liver hydatids are potentially infected. Biliary fistula is very common, and it is this liability to infection after operation that makes marsupialization, with or without tube drainage, the procedure so commonly adopted. The large cavity takes considerable time to become obliterated by falling in of its walls and the growth of granulation tissue. Secondary infection with its attending evils takes its toll if drainage is done. In cavities presumably sterile (though there is always the risk of the entry of bile, with resulting low-grade infection), one may adopt the method of filling the cavity

with normal saline followed by closure of the cyst. Russell[5] adopted this method with success in infected cysts. Gross infection is an indication for drainage. An intermediate course is probably the safest procedure. The cyst is filled with saline to which some non-irritating antiseptic such as flavine may be added, and is closed tightly. The line of suture is then attached to the peritoneal opening, or a tube is carried down to the vicinity of the cyst. Should suppuration occur, there will be spontaneous drainage, or, if this fails, a tube may be readily inserted.

Calcification of the pericyst is always troublesome, and attempts at removal usually result in severe hæmorrhage. Recurrent abscesses and persistent sinuses are often present, necessitating a lengthy convalescence.

The grossly infected hydatid demands free drainage and the same general and local surgical measures required in any abscess cavity of this organ.

I wish to express my thanks to the Pathological Department of the University of Otago Medical School for the preparation of the specimen and photographs, and to Sir Louis Barnett for much help and advice.

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RENAL CALCULI WITH SQUAMOUS CARCINOMA IN A HYDRONEPHROTIC KIDNEY.

By L. WOODHOUSE PRICE,
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UROLOGIST TO THE GLASGOW ROYAL INFIRMARY.

A CASE of epithelioma occurring in a horseshoe kidney with giant renal calculus has been described by Willan.[1] The following case seems worthy of being placed on record as another example of the somewhat rare occurrence of primary squamous carcinoma in this situation.

FIG. 437.—Hemisection of removed kidney, showing extensive cystic dilatation, with multiple calculi and the tumour in the lower segment.

HISTORY.—The patient, a labourer of 54, was referred to the Urological Clinic at the Glasgow Royal Infirmary complaining of left lumbar pain. This had been present practically without intermission for a year. There were periods when the pains became exacerbated and radiated to the left testicle. He also complained of inability to keep his food down, and stated that, as a

result, he had lost two stone in the last few months. Although he apparently considered that his complaint was only of one year's duration, he admitted that he had been subjected to intermittent attacks of discomfort in the left renal area for a period extending over eighteen years. He did not suffer from urinary frequency or dysuria, though he had noticed that his urine was 'muddy'.

On Examination.—A large mass could be felt in the left abdomen, extending from under the left costal margin down to the iliac region. The urine contained albumin, blood, and pus. A radiographic examination showed shadows of at least eleven calculi of varying dimensions occupying an area extending from below the iliac crest upwards to the level of the 2nd lumbar vertebra. An intravenous pyelogram adequately demonstrated

Fig. 438.—Infiltration of the fibrotic renal parenchyma with irregular masses of squamous carcinoma. (× 60.)

a normal renal pelvis on the right side and a very gross hydronephrosis on the left, fifteen minutes after the injection of 40 grm. of uroselectan.

Operation.—The kidney was exposed through a curved lumbar extraperitoneal incision. Although the external arcuate ligament was cut and the incision prolonged forwards to beyond the level of the anterior superior spine, great difficulty was experienced in attempting to deliver the organ on account of its size. After resecting the twelfth rib, however, this was successfully accomplished. Following on division of the ureter and ligature of the pedicle the kidney (*Fig.* 437) was removed without further trouble. A rubber drainage-tube was inserted at the upper angle of the wound and the incision closed.

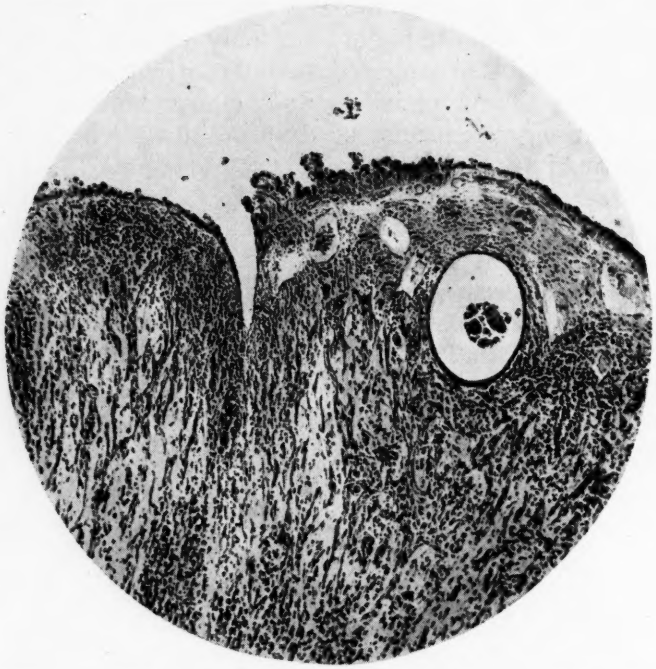

FIG. 439.—Ulceration of the transitional epithelium of the renal pelvis from irritation by calculi, and columns of malignant cells infiltrating the fibrotic renal parenchyma. (× 60).

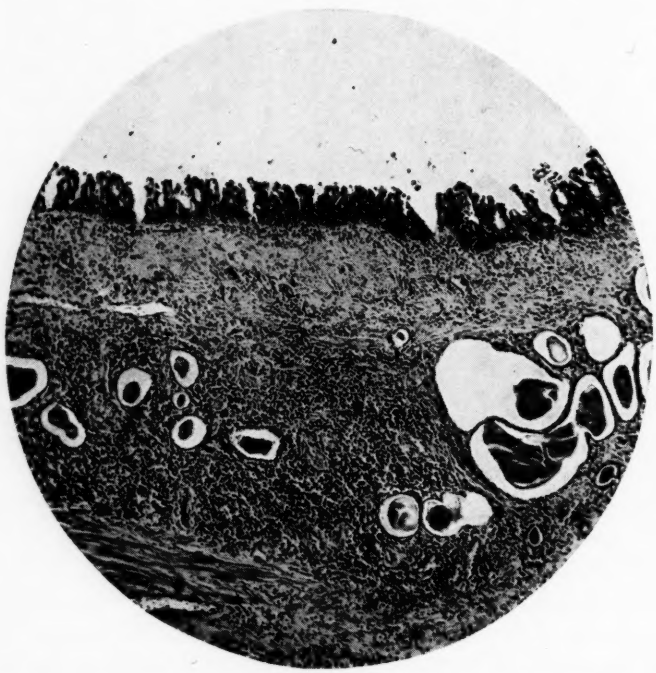

FIG. 440.—Transitional epithelium lining a dilated calix in the neighbourhood of the tumour, showing a tendency to undergo hyperplasia. The underlying renal tissue shows chronic inflammatory change. (× 60).

The patient left the operation theatre in good condition, but a few hours later exhibited symptoms of severe shock which lasted until the following day. There followed an uninterrupted convalescence, and he left hospital twenty-one days after operation.

PATHOLOGICAL ANATOMY.—The kidney was enlarged, measuring 7½ in. from pole to pole and 4½ in. in its greatest transverse diameter. The surface was coarsely lobulated, and the organ was obviously cystic and contained fluid. There was a considerable amount of perirenal fat, especially around the pelvis of the organ. On dissection the pelvis and first inch of the ureter were found to be obstructed by a large calculus of the 'stag-horn' type which was firmly adherent to the lining membrane of the ureter. The pelvis, ureter, and neighbouring renal tissue were thickened and indurated. The surface of the organ showed a number of punctate hæmorrhages, most marked in the region of the lower pole. While the greater part of the organ appeared cystic, the lower pole showed a solid mass of tissue, almost white in colour, projecting as a nodule the size of a walnut towards its posterior aspect. This mass appeared to be completely separated from the pelvis by cystic renal parenchyma.

On hemisection of the organ the renal parenchyma was found to be practically obliterated, being reduced to a thin shell of tissue not more than 1 mm. in thickness. The interior of the organ was occupied by large cystic spaces containing fluid, separated from each other to a greater or lesser extent by greatly attenuated renal substance. The region normally occupied by the pyramids contained a quantity of dense fibro-fatty tissue, partly embedded in which were a number of large irregular calculi. The normal configuration of the kidney could not be distinguished. At the lower pole the dilated calix was partly occupied by a cauliflower-like tumour about the size of a large walnut. In the centre of the tumour mass were two irregular spaces occupied by a number of small faceted calculi. Distributed irregularly in the fibro-fatty tissue of the central portion of the organ, but occupying chiefly the lower half, were several large calculi.

HISTOLOGY.—Sections prepared from tissue removed from the tumour occupying the lower pole of the kidney showed the structure of a squamous-celled carcinoma. This presumably arose in the epithelium of the lower calix, which had undergone squamous metaplasia, as the transitional epithelium in this region showed hyperplasia and in places a definite tendency to assume squamous characteristics. The epithelium of the pelvis and upper end of the ureter, on the other hand, though ulcerated from the presence of calculi, showed no evidence of hyperplasia or of squamous metaplasia. The accompanying microphotographs (*Figs.* 438–440) illustrate the histology of the neoplasm and of the diseased renal parenchyma.

REFERENCE.

[1] WILLAN, R. J., "Giant Renal Calculus with Epithelioma in a Horseshoe Kidney", *Brit. Jour. Surg.*, 1928, xvi, 317.

CONCERNING THE PATHOLOGY OF TUMOURS OF TENDON-SHEATHS.

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THE great majority of the reports and descriptions of tendon-sheath tumours emphasize the yellow colour of the growths, the presence of giant cells, or other incidental features. In recent years an attempt has been made to express the characteristics of tumours and their relationship to cells in various parts of the body by the use of terms which indicate the nature of the cells comprising the growth, such as 'hepatoma', luteoma', 'meningioma', etc. The same idea has been applied to synovial membranes by the use of the term 'synovioma'. This has resulted from the realization that the potentialities of tumours must depend on the nature of the cells from which the growths arise and of which they are composed. An appreciation of these growths can be achieved only by way of normal and abnormal synovial membranes.

HISTORICAL.

A continuous synovial lining was described first in 1763 by Bonn, and in 1800 Bichat showed that the 'Haversian glands' were not mucus-producing but consisted of fat. Originally joints were thought to be lined by epithelium, but the descriptions by His and Remak of the developmental relations of the three germinal layers led to this hypothesis being discarded. It was replaced by the idea of an 'endothelial' lining—a view championed by Schweigger-Seidel, Landzert, Steinberg, Colomiotti, Bentzen, and Tillmans.

In 1866 Hueter, by using a silver impregnation method, came to the conclusion that the lining of joints was not continuous, but incomplete and irregular. His view was upheld by Reyher, van der Sluijs, Hagen-Torn, Hammar, Braun, and Tourneux and Herrmann. A modification of Hueter's view, that the synovial membrane is a specialized connective-tissue surface, was introduced in 1910 by Lubosch. This was supported by Segale, and has now received ample confirmation. It is astonishing that most discussions on the subject of joint or tendon-sheath synovial membranes disregard completely all this work and refer to 'endothelial linings'. It is proposed to demonstrate that the nature of the tumours depends directly on the normal histological character of the tissue of the tendon-sheaths.

The first example of a tendon-sheath tumour was reported in 1852 by Chassaignac. This description was followed by others—Spencer Wells (1857), Billroth, Czerny (1868), and others—until 1882, when, in addition to clinical and macroscopic examination, histological investigations were undertaken.

Tourneux, who gives a very full account of the literature, describes this as the period of clinical observations. His second or histological period includes observations made by Zwicke (1882), Markoe (1884), and Reverdin (1885) amongst others. The end of this period was in 1891—marked by the work of Heurtaux. From this time onwards there have been numerous observations and a number of attempts to classify these growths. In 1892 Dor described the xanthoma cells occurring in these tumours. In 1901 Bellamy, writing from Professor Stilling's laboratory in Lausanne, discussed 5 examples and concluded that the growths should be classed with the endotheliomata. Rosenthal in 1909 discussed 71 cases, and in 1913 Tourneux referred to 93 cases. In 1915 Stewart and Flint reported 2 cases and, reviewing the literature, referred to 9 occurring before 1913 which had been overlooked by Tourneux. Fleissig suggested that many of them—the giant-celled tumours—were not neoplastic, but the result of a chronic inflammatory process. From this time onwards there have been only a few examples reported. Fourteen cases from the Mayo Clinic were described by Broders in 1919.

One of the striking features of all the reports and discussions is that most attention has been directed towards the presence of the foam cells (xanthoma cells) or the giant cells. Few attempts at histogenetic investigation have been made. In 1923 Buxton gave a classification of the growths according to the cell type, but did not indicate the relationships of these to each other or to the normal cells of the part. In 1928 Janik gave a more complete classification, but his work is open to the same criticism.

CLINICAL CHARACTERS.

The tendon-sheath tumours are insidious in onset. There is seldom pain, and the most constant observation is that of a swelling in the region of a tendon, most frequently in the hand. When first noticed the swelling may be small, or it may reach the size of a small orange before the patient seeks attention. It may be localized or may extend along the tendon. They usually grow very slowly, thus accounting for the absence of disturbance of the surrounding tissue.

Trauma is an important feature, particularly in the cases which show giant cells and foamy cells. The relationship is shown by the observation that such a large number of the growths occur on the flexor tendons of the right hand. Where the tumour was situated on the left hand, in the case described by Malherbe, the patient proved to be left-handed. The tumours are usually rounded in shape, are frequently lobulated, and possess a smooth surface. They vary considerably in consistence. In the early stages the growth does not interfere with movements, but later, either because it occurs at the region of a joint or because it invades it, function may be disturbed. The majority of the tumours are innocent, but a small proportion are malignant—some of them extremely so. Inadequate removal is liable to be followed by recurrence. If the tumour is near a muscle, this is invaded first, and later the other tissues are involved. In non-muscular regions the surrounding tissue is involved first, and later the tendon is itself affected.

When the skin becomes involved by the tumour, it becomes bluish and finally breaks down and the neoplasm fungates (*Figs.* 441, 442). (Czerny, Leclerc, and Bolognesi.) Infection of the tumour and subcutaneous tissues with sloughing occurs. Metastases are uncommon. They may occur in the regional lymph-glands (Bolognesi, Gaudiani, Leclerc, and Morestin). Visceral metastases are rare, but have been reported in the liver and lungs.

MACROSCOPIC APPEARANCES.

The tumours of tendon-sheaths are reddish-yellow, yellow, or grey in colour. They are attached to the sheath and may involve it for a considerable portion of its length on one aspect of the tendon, or may completely surround the tendon. At other times they are attached to the sheath

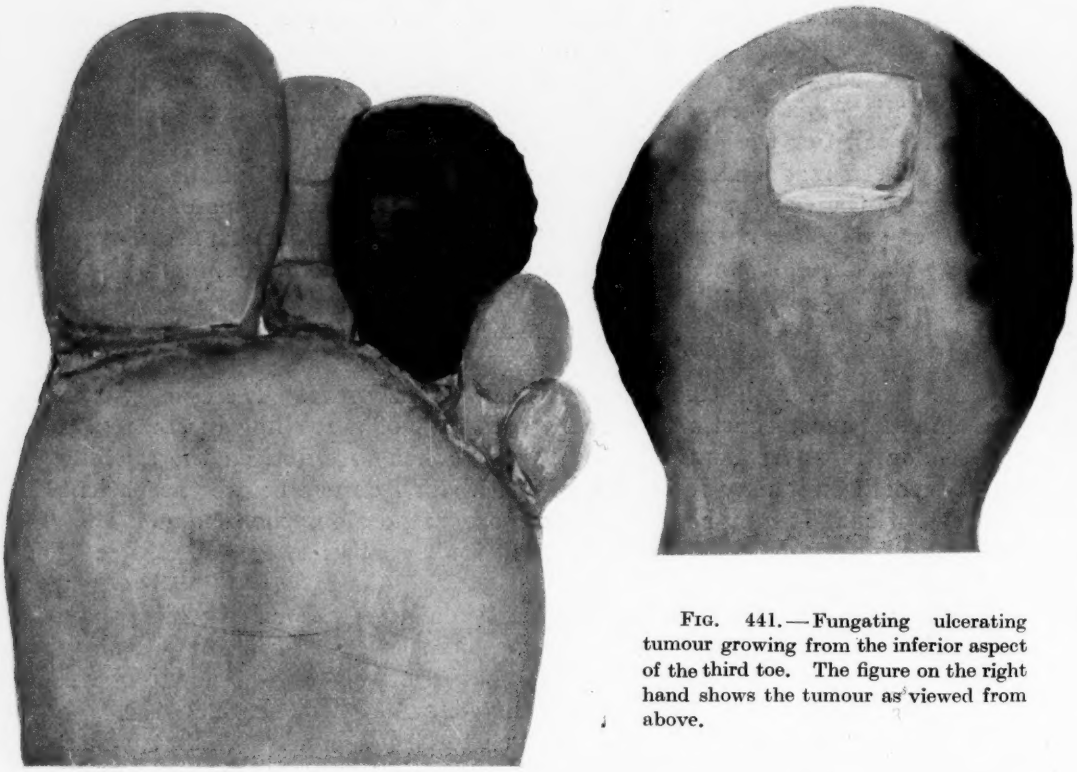

FIG. 441.—Fungating ulcerating tumour growing from the inferior aspect of the third toe. The figure on the right hand shows the tumour as viewed from above.

by a narrow pedicle. Their consistence varies with the nature of the growth. A very cellular growth is soft, and an admixture of fibrous tissue gives a firmness which varies with its amount. Calcareous material was observed by Billroth and by Czerny, and cartilaginous fragments by Heller. A complete chondroma was reported by Brenckmann, Buxton, Chauvain and Roux, Delbet, and Ombrédanne. A fibroma has been described by Buxton, Sendler, Sprengel, and Torek amongst others. The growths may be fatty

in both macroscopic and microscopic appearance (Meyer, Sendler, Sprengel, and others). Angioma and lymphangio-endothelioma (Faldini) have been reported.

On section, cellular, rapidly growing varieties are soft and of a uniform colour, and have an indefinite margin. Less rapidly growing forms are less

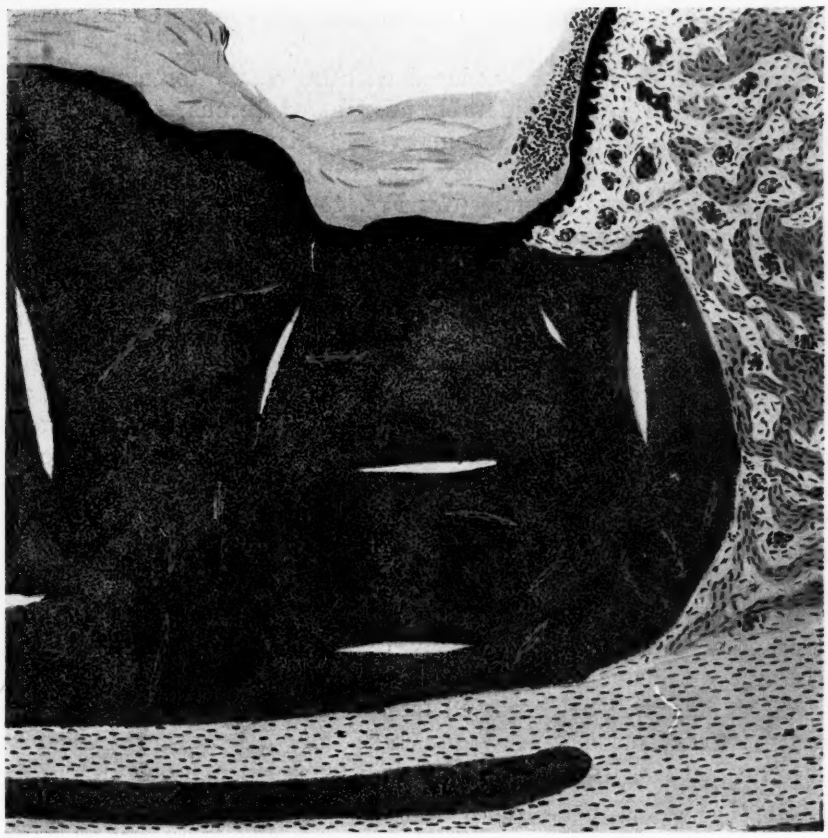

FIG. 442.—Microscopical section of the tumour shown in *Fig.* 441. The growth has invaded the tendon and also the overlying skin. 'Synovial' spaces are present throughout the substance of the tumour.

vascular, harder in consistence, and more definitely delimited. Some tumours resemble examples of chronic tenosynovitis, and it may be possible to distinguish them only after microscopic examination, e.g., by the presence of a greater number of mitotic figures than would be expected in inflammatory lesions (*see Fig.* 477).

MICROSCOPIC APPEARANCES.

Benign Varieties.—The innocent forms consist of variable proportions of spindle and spheroidal cells.

The Spindle Cells are somewhat variable in shape, showing an irregular, indefinite outline with well-marked protoplasmic processes. Sometimes one

end is expanded and the other is pointed. They resemble fibroblasts of various ages, and show all gradations into spheroidal cells. The protoplasm stains lightly with the counterstain and is homogeneous. There are sometimes present a few vacuoles of small size. The nucleus varies from an elongated to an oval form. It may be comma-shaped or triangular, etc. Some are small and pyknotic, while others are larger with an openwork chromatin net. One or two chromatin knots are present. Occasional mitotic figures are also present.

In parts the cells are closely placed with but few intercellular fibrils, but in other places there is a considerable amount of fibrous tissue. In some of the tumours (the so-called xanthomata and giant-cell tumours) there are many foamy cells, and in parts they may predominate. Giant cells may be present in considerable numbers. (*See Fig.* 444.)

The foamy cells are spheroidal in shape and contain a large number of fat-droplets, presenting a characteristic appearance. The true cells of the neoplasm, however, may be seen between these cells (*Fig.* 446), even where the foamy cells predominate. (*See Figs.* 456, 457.) In *Fig.* 457 the tumour cells lining the space are included in the section.

Giant cells are of the foreign-body type (*Fig.* 445). They possess a considerable amount of granular protoplasm; the nuclei are small and similar to those of endothelial cells. Usually the nuclei are scattered irregularly through the protoplasm.

In many tumours some cells develop capsules, lose their processes, and resemble cartilage. Typical cartilage may be found and may comprise the whole tumour. Areas of mucoid change are frequent and are of two types. The first variety is the typical mucoid connective tissue seen in many connective-tissue tumours, particularly of the osteogenic type. This form has not been extensive in any of the growths examined by the writer. The second variety will be discussed later.

True fat tissue, as distinct from the foamy cells, occurs, and may predominate the picture, forming a 'lipoma' as described by Billroth, Mannini, Sendler, Sprengel, Strauss, and Tichoff, etc. It may occur as a papillary projection into the tendon-sheath space, giving rise to the lipoma arborescens, or it may be sessile. Bone occurs in some cases, and mixed tumours containing cartilage, bone, and mucoid tissue, such as the excellent examples described by Janik, may be found.

The Spheroidal Cells are arranged in more or less well-defined groups (*Fig.* 447). The cells are closely packed, and polygonal in shape (*Fig.* 449). There is a fairly definite cell outline. The protoplasm is lightly staining, non-granular, and vacuolated. The nuclei are rounded, oval, or sometimes indented, possessing a fine chromatin network. Some of the nuclei are particularly large. Occasional mitotic figures are present (*see Fig.* 477). Some of the cells are multinucleated.

In many parts this tissue merges into an acellular mucoid material (*Fig.* 448). The cells become fewer and larger. The cell walls become more definite and the nuclei smaller and pyknotic. The protoplasm undergoes concomitant changes, a number of large non-staining vacuoles forming.

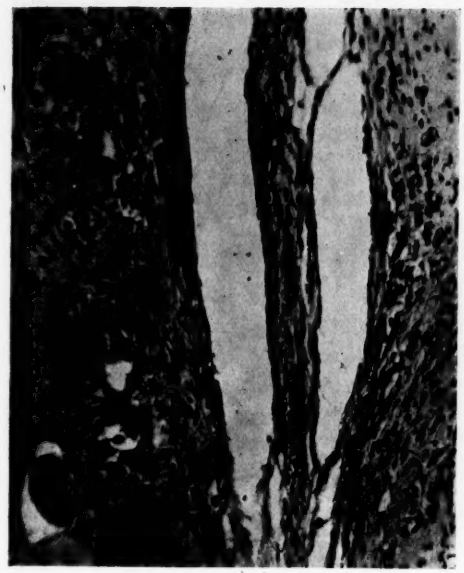

FIG. 443.—Photomicrograph of a section of a tumour removed from the thumb. The tissue lining the space resembles that of synovial membrane, and is of the fibrous type. (Cf. *Figs.* 456 and 457.) (× 80.)

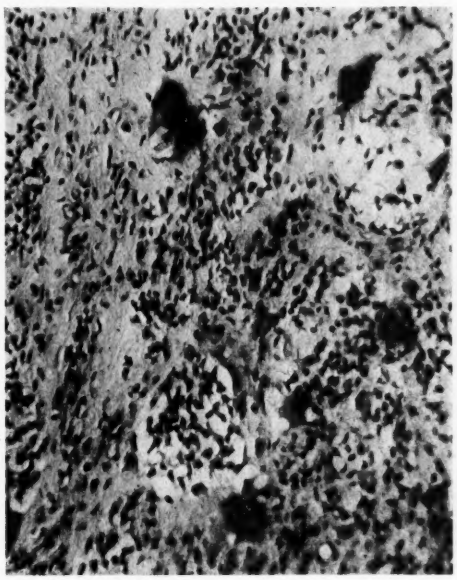

FIG. 444.—Photomicrograph of another portion of the growth shown in *Fig.* 443. Giant cells and foam cells are present. (× 80.)

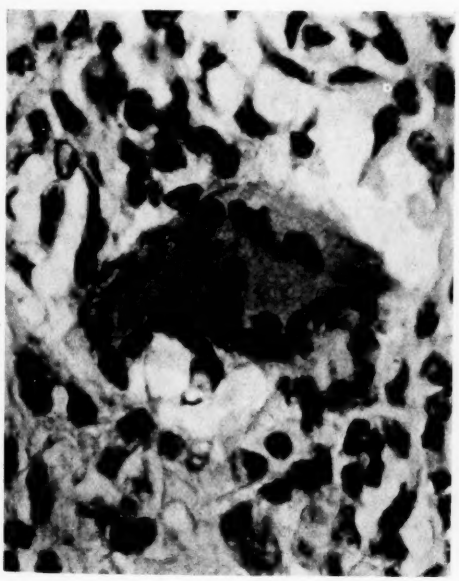

FIG. 445.—A higher power view of one of the giant cells in an area similar to that shown in *Fig.* 444. (× 540.)

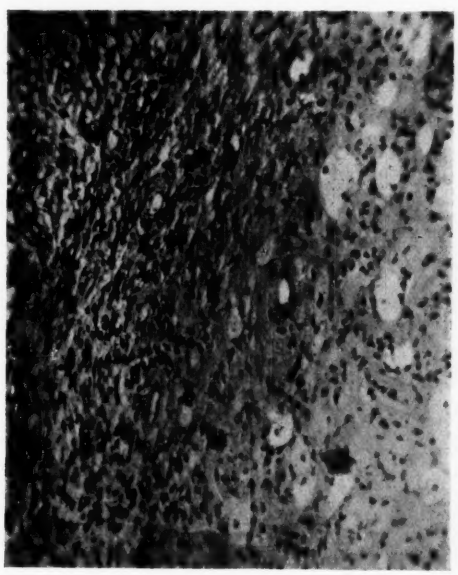

FIG. 446.—Another portion of the tumour shown in *Fig.* 443. Lipoid-containing cells are merging into fibrous tissue. (× 80.)

Homogeneous intercellular material appears between the cells until only mucoid material containing some débris consisting of fragmented nuclei and some vacuolated protoplasm is present to the exclusion of all organized tissue. The material stains bluish with hæmatoxylin. These changes are very similar to those observed in ganglion formation.

Throughout all the tumours definite spaces occur amongst the cells (*Fig.* 443). These vary in size from small cavities little larger than the neighbouring blood-vessels to spaces occupying in length one or two low-power fields. These spaces occur in tissue of all types. They are lined by some of the tumour cells. The cells are surrounded by collagenous material, and though some are on the surface, others are just below the surface sending processes to it, and others are completely submerged. (Cf. *Figs.* 453 and 469.) These cells are continuous with the deeper cells of the tumour. They may be spindle (*Fig.* 450) or spheroidal cells (*Fig.* 459), or they may be fat-containing (*Fig.* 456). In many sections the cavities may be few and far apart, so that some areas are solid (*Fig.* 446).

Papillary growths occur into some of the cavities and resemble the papillæ seen in chronic tenosynovitis. These papillæ in some cases contain small round cells (*see Fig.* 451), indicating an inflammatory element in these growths. There are numerous droplets of various sizes in the protoplasm, suggesting a secretion. The vessels are well formed and are distinguishable from the tissue spaces mentioned.

Malignant Varieties.—The malignant forms of tumours may be interpreted when the innocent tumours have been studied. Most of the features are reproduced. The cells are of the same type, but are more irregular and 'embryonic' in form (*Fig.* 468). They are spindle and spheroidal (*Fig.* 461), the cell boundaries are poorly defined, the nuclei very active, and numerous mitotic figures are present (*Fig.* 462). A variable amount of intercellular material is present. The spaces observed in the other growths are present here also. There is much more variation in their size and form, and the surface is much less regularly delimited (*Fig.* 465).

The lining cells may be multi-layered. Papillary projections occur (*Figs.* 466, 473), and these resemble those seen in the other form of growth except that the cells are more anaplastic (*Fig.* 467). Examining any one portion carefully, a marked resemblance to the tumours of synovial membrane, and even to hyperplastic synovial membrane itself, is to be observed. (Cf. *Figs.* 464, 460, and 469.)

The vessels are similar to those common in other malignant connective-tissue neoplasms. They are vascular spaces lined usually by the cells of the tumour, and vary in size and shape. I consider it probable that some of the angiomatous tumours of the tendons are true synovial growths which are somewhat vascular, and in which the gross similarity of the synovial spaces to the vascular spaces has led to the opinion that all are vascular in origin. (*See Fig.* 463.)

It is necessary now to consider in detail the structure of synovial membranes.

FIG. 447.—Photomicrograph of a portion of a tumour. The cells are of the spheroidal type and some degeneration is present. (*See Fig.* 459.) (× 25.)

FIG. 448.—Another portion of the tumour shown in *Fig.* 447. The mucoid material, which macroscopically closely resembled that seen in a ganglion, is shown. (× 25.)

FIG. 449.—A higher-power view of the tissue seen in *Figs.* 447, 448. The irregularity in the size of the nuclei is seen. (*See Fig.* 454.) (× 160.)

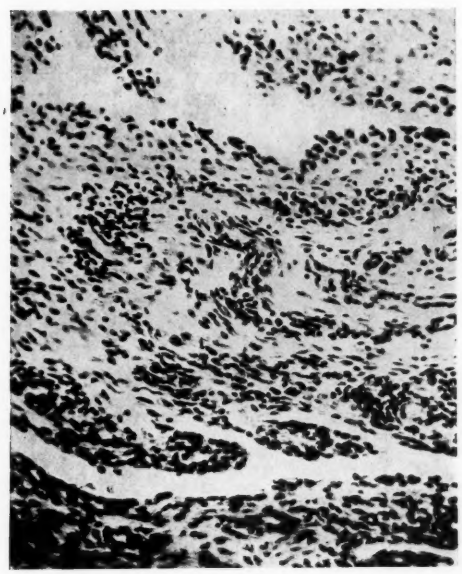

FIG. 450.—Section of a tendon-sheath tumour showing a number of 'synovial' spaces. (× 80.)

NORMAL HISTOLOGY OF SYNOVIAL MEMBRANES.

A discussion of the histology of the synovial membranes resolves itself into several subdivisions: (1) The synovial cells; (2) The varieties of structure of membranes; (3) Villus formation; (4) Transitions of structure to cartilage formation; (5) Vascular channels.

1. The Synovial Cells.—As previously stated, the 'synovial membrane' consists of a specialized free connective-tissue surface (*Fig.* 471). The cells are of a modified connective-tissue type: some are arranged along the surface, and may be very numerous in some areas (*Fig.* 472), giving the 'cell-rich' type of membrane described by Hammar. In other parts the cells are fewer, giving the 'cell-poor' type (*Fig.* 469). This layer merges gradually into the subjacent tissue, so that no line of demarcation can be found. The cells are surrounded by collagenous tissue. Some of them are on the surface; others are on the surface only in part, or send processes to the surface, while others are completely embedded. Spheroidal cells are found in the cellular areas.

The cell body is usually very irregular in shape, and possesses several small blunted processes. The protoplasm is pale, homogeneous, and stains faintly with eosin. It contains a small number of mitochondria and there is extremely little intracellular fat. Occasionally vacuoles are present in the cells, but the nature of the contents of these spaces is unknown (Key). The nuclei stain deeply and contain a coarse chromatin network. Various forms have been described by Hammar (branched, triangular, curved, spiral, and pyknotic nuclei). These indicate, however, no essential difference, but are merely due to mechanical, physiological, or age alterations. Sometimes the synovial cells may have more than one nucleus.

2. Variations in the Structure of Synovial Membrane.—Key has pointed out that the actual synovial cells are of the same form in all parts of joints and bursæ, etc., but that the underlying tissue is different in different positions. Thus he describes an areolar type, a fibrous type, and an adipose type of synovial membrane. It is not necessary to discuss these varieties here, except to mention that the peculiarities of the synovial cells in relation to the underlying fibrous or fat tissue is mimicked closely by some of the neoplasms. In this respect the adipose type is of special interest. The synovial cells cover the surface of the fat tissue and a few cells may lie between the fat cells. The synovial cells are surrounded by collagenous material and they may be cuboidal in form. In some of the tumours where there are a large number of foamy cells, these fat-containing cells may bear the same relationship to the cells of the tumour as do the ordinary fat cells in adipose synovial membrane (*see Fig.* 457).

3. Villi.—These are circumscribed projections of the synovial surface of a joint or bursa. They occur in cases of chronic inflammation of tendon-sheaths and in tumours, and are bordered by the synovial cells in the same manner as other parts of the 'membrane'. Usually they are much more cellular than other portions and are very vascular. They correspond in structure with the portion of tissue from which they arise, and may be areolar, fibrous, or, to a less extent, even fatty in type.

FIG. 451.—Photomicrograph showing the appearance presented by papillary projections into a space occurring in a tendon-sheath tumour. Compare with higher-power view (*Fig.* 460), and with inflamed joint synovial membrane (*Fig.* 472). Cells of inflammation are present in the papillæ. (× 80.)

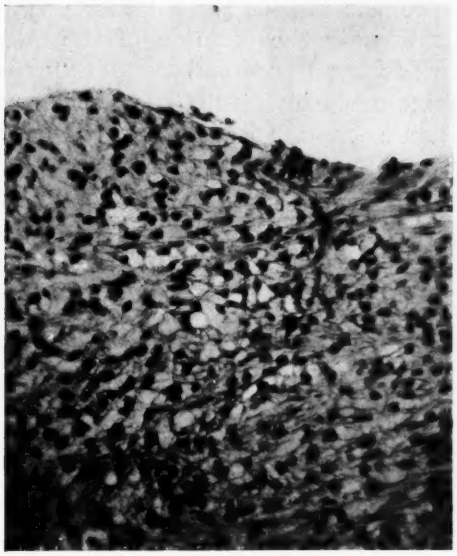

FIG. 452.—Photomicrograph showing the tumour tissue lining one of the spaces shown in *Fig.* 442.

FIG. 453.—High-power view of the tissue shown in *Fig.* 452. Compare with the synovial membrane shown in *Figs.* 469 and 470. (× 540.)

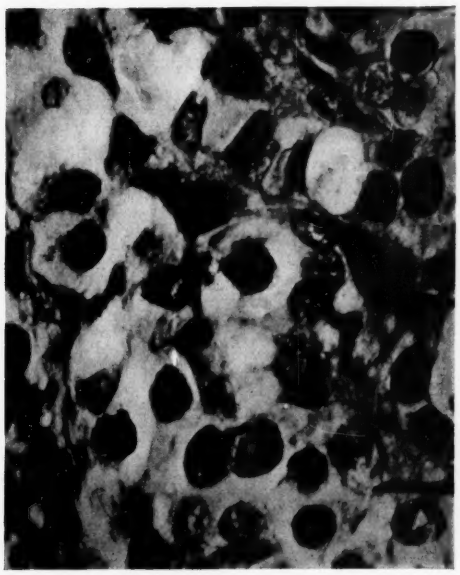

FIG. 454.—High-power view of the tissue shown in *Figs.* 447–449. (× 720.)

4. Transition of Synovial Cells to Other Forms.—In the fibrous areas the cells are arranged parallel with each other. In some portions, particularly near the junction of the membrane with cartilage, the cells are more widely separated and irregularly spaced. They lose their processes and they become enclosed in lacunæ, and a gradual transition from the typical synovial tissue through a pseudo-cartilage to a true cartilage occurs. In consideration of this normal relationship of the synovial and cartilage cells, the occurrence of cartilage in 'synovial membrane' is readily understood. Bone also occurs at times. These relationships are very important in the consideration of the so-called 'chondroma' of tendon-sheaths.

5. Blood- and Lymph-vessels.—Synovial tissue is richly supplied with both blood and lymphatic vessels. The relationships of these last have not been completely elucidated. A direct connection of the lymphatic vessels with synovial cavities is now held to be improbable. Many blood-vessels are present, particularly in the villi. It is apparent that the endothelial cells lining these vessels morphologically resemble the synovial cells, so that vascular spaces can be interpreted only after careful examination.

DISCUSSION.

Tumours of tendon-sheaths possess features which have attracted considerable attention and led to many differences of opinion. The first histological investigations led to the conclusion that the tumours were sarcomata, e.g., sarcoma globo-cellulaire, sarcoma fuso-cellulaire, myxofibrosarcoma, etc. Later, other interpretations were made—for example, Bellamy regarded the tumours as being endotheliomata. In 1913 Fleissig suggested that the giant-cell tumours were not neoplastic but chronic inflammatory conditions, and a similar opinion was expressed by Dunn. This was another distinct advance in our appreciation of these growths.

The interesting feature of most of the investigations into these tumours is that they refer almost entirely to the presence of the giant cells, foamy cells, etc., and these are discussed to the almost complete exclusion of any other morphological characteristics. Giant cells occur in many circumstances, as do also the foamy cells of xanthomata, so that it is to the type cell of the tumours that we must look for an understanding of these growths. Since the tumours arise from the sheaths of the tendons, a knowledge of their normal histology is essential. Not much is known concerning their structure except that it is similar to the lining of joints and bursæ. This lining is a specialized connective tissue (*Fig.* 470), and the characters of the cells are duplicated in the cells of the tumours derived from the synovial membrane (*Fig.* 460)—in this case the synovial lining of the sheath of the tendons.

The specialized cells of the synovial membrane form a surface for the tissue surrounding the synovial space. The cells of the tumour, in a similar manner, form the lining of spaces which occur throughout the growth (*Figs.* 443, 452, 456, 457, 459, 465, 466). This feature is one of the characteristics of this form of tumour, and has been overlooked in the too close attention devoted to other features. These spaces appeared to have caused Bellamy to regard the growths as being endotheliomata, but he failed to appreciate

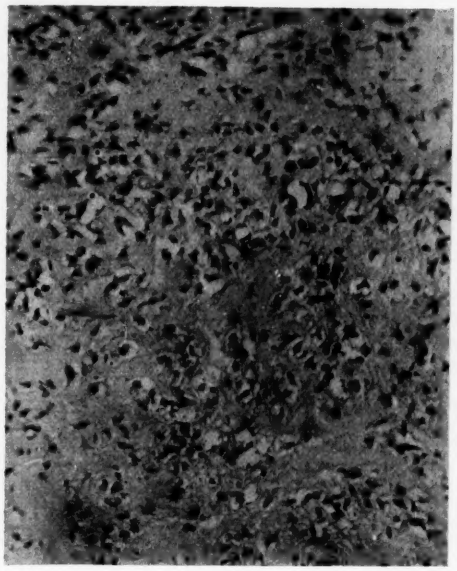

FIG. 455.—Section of a tendon-sheath tumour showing the tissue merging into a cartilage-like structure. (× 80.)

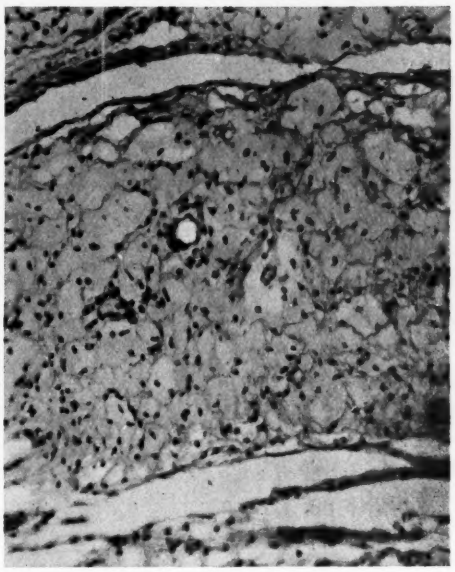

FIG. 456.—Photomicrograph of a portion of the tumour seen in *Fig.* 443. The cells contain a large amount of fatty material, but the characteristic spaces are present. (× 80.)

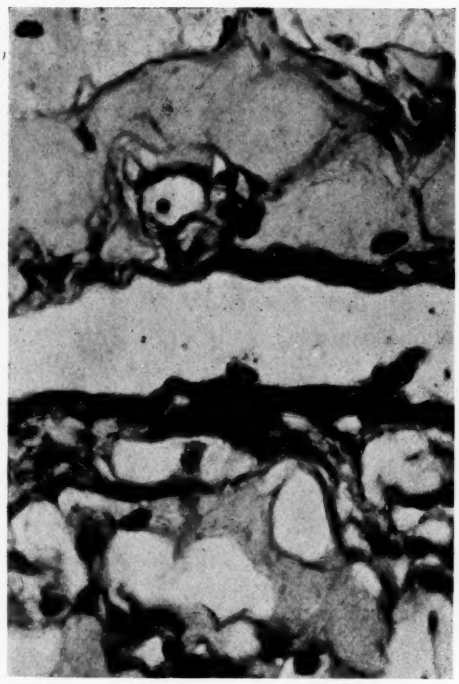

FIG. 457.—High-power view of the tissue shown in *Fig.* 456. The ' synovial ' cells are observed lining the space and also lying between fat-laden cells. (× 540.)

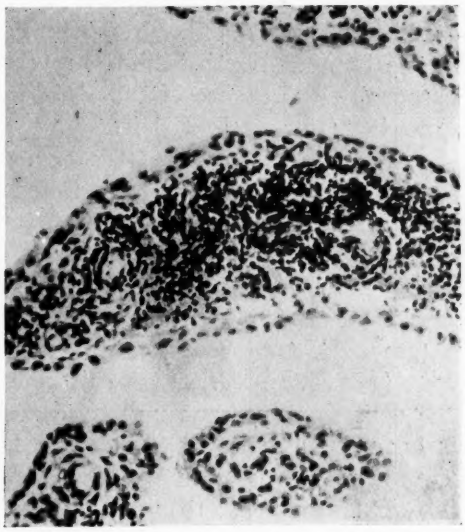

FIG. 458.—Section showing papillæ occurring in a tumour. There is a resemblance to the appearances observed in a chronic tenosynovitis. (× 80.)

that the spaces are not lined by endothelial cells. A casual glance at some sections gives the impression that an endothelial lining is present, but a more complete examination shows that the morphology and arrangement of the cells differ from those of endothelium.

The type cells of the tumours have been discussed. They are spindle and spheroidal in shape, and these forms merge from one into the other and apparently proliferate, with the formation of spaces in the tissue which are comparable with synovial cavities. They are similar to those seen in synovial membranes. The occurrence of synovial spaces amongst the cells should be emphasized. These have been mistaken for vascular channels, blood or lymphatic, so that the evidence for the view that they represent synovial spaces must be considered. These cavities are large elongate hiatuses lined by tumour cells. They are usually much larger than blood or lymphatic spaces in tumours of this character, especially in the more slowly growing innocent varieties. Also they are different from the vascular spaces which are present in the tumours.

The cells lining the spaces are the cells of the tumour; endothelial cells are absent, and the same arrangement of cells as is present in the normal synovial membrane occurs. Immediately subjacent to the surface there may be fibrous tissue or fatty tissue (in the case of the 'xanthomatous' tumours, lipoid-containing cells), as occurs in the normal synovial membranes. Blood-corpuscles are usually absent, and in the cases in which I have observed them they have been present extravasated also throughout the tumour, suggesting that their presence was, in all probability, due to the trauma of operation.

Papillary projections occur in some of these spaces (*Figs.* 451 and 458), particularly in the malignant forms (*Fig.* 466), and though intravascular papillary developments have been described in endotheliomata, those observed in the tendon-sheath tumours resemble more closely the papillary projections observed in the cases of chronic inflammation of joints or in chronic teno-synovitis (Forgue and Étienne).

The mechanism of formation of the synovial spaces is of interest. In the more slowly-growing varieties, a simple split appears to occur in the direction of the parallel intercellular fibrils and cells (*Fig.* 443). In the more rapidly growing varieties, however, a condensation or accumulation of cells occurs along a definite line (*see Fig.* 475). This is reminiscent of the 'condensation' of cells which occurs in embryological tissues prior to the formation of a lumen. Later, a line of cleavage occurs in the region of the proliferated cells (*Fig.* 476). Whether this occurs by degeneration of, or secretion from, the cells is at present undetermined, but the appearances suggest to me that it occurs by secretion. It is to be appreciated that this interpretation of the formation of lumina is purely hypothetical. The great difficulty in drawing deductions in pathological histology is that it is necessary to "translate spatial relationships into those of time". This is very likely to lead one into error. With this consideration in mind, however, I feel that the evidence, though incomplete, is strongly in favour of the suggestion put forward above.

In the most malignant tumours it is in the cellular areas that the 'synovial' spaces occur, so that it is probable that the method of formation is similar; but in these cases the mechanism is more difficult to follow and

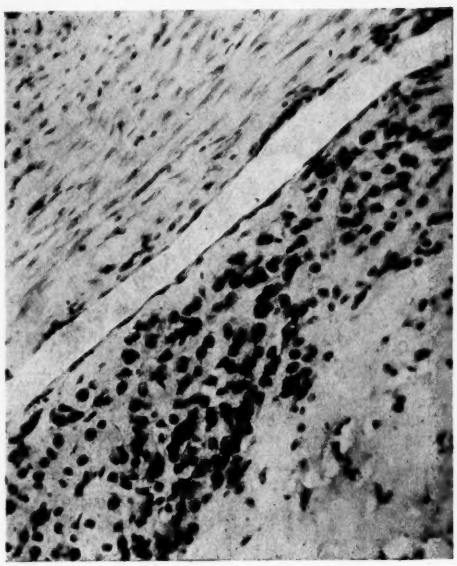

FIG. 459.—A portion of the tumour shown in *Fig.* 447. A typical space is present, having spindle cells on one aspect and spheroidal cells on the other. Mucoid material is present amongst these round cells. (× 80.)

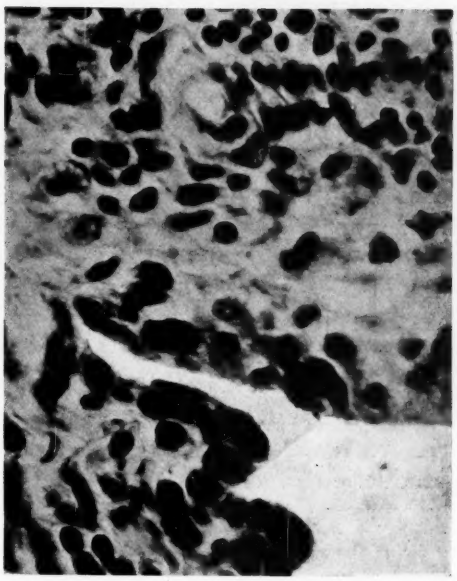

FIG. 460.—Photomicrograph showing the cells lining a space which occurred in one of the tumours. (*See Fig.* 451.) (× 540.)

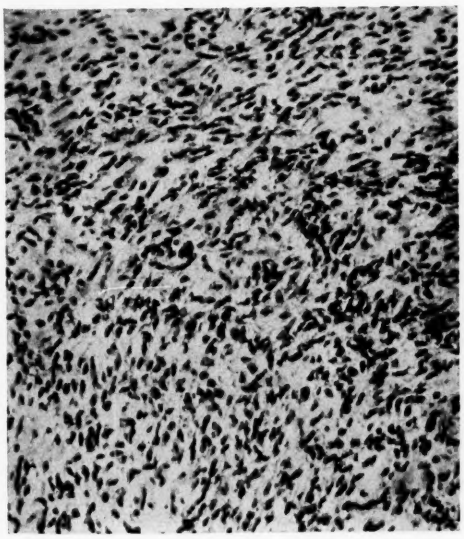

FIG. 461.—Photomicrograph of a portion of a malignant tendon-sheath tumour. This appearance would be labelled spindle-cell or mixed-cell sarcoma. (*See Fig.* 466.) (× 70.)

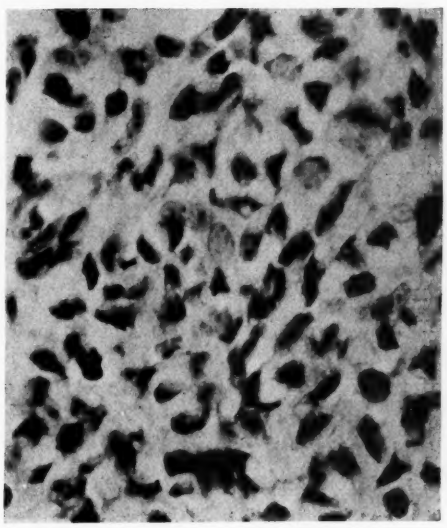

FIG. 462.—Higher-power view of the tumour shown in *Fig.* 461. (× 450.)

interpretation is even more liable to error (*Fig.* 473). The papillary growths arise from the excess focal proliferation of the cells in one area. This forms a papillary projection from which secondary papillæ may arise. These are usually very vascular. Often the cells on the surface resemble endothelial cells, but close investigation shows that this is only a superficial similarity. The structure of the protoplasm suggests that they have a secretory function, but this is not proven at present. Droplets similar to those seen in these cells have been observed in the cells of the normal synovial membrane, but it has not been possible to stain them (Key).

Another interesting discovery in these tumours is that of tissue resembling cartilage (*Fig.* 455), and even, in some cases, actual cartilage. Examination of synovial membrane in the region of joints shows that the synovial cells merge, by insensible gradations, into the cartilage cells of the articular surfaces of the bones—that is, the synovial cells in certain situations, and presumably under certain influences (biophysical or biochemical), may give rise to cartilage. If the cells, therefore, possess the potentialities for the production of cartilage as well as other varieties of connective tissue, it is unnecessary to postulate cell-rests of primitive osseous or cartilaginous tissues in the sheath of the tendon at the site of the growth in order to explain these aberrant tissues. This occurrence is merely the expression of the capabilities of the cells towards the formation of other tissues when exposed to the adequate stimulus, and applies also to the production of mucoid tissue and bone.

This brings us to the problem of terminology and classification, which has been a somewhat vexed question. The nomenclature includes giant-cell tumour, myeloma, myeloid sarcoma, giant-cell sarcoma, myeloid tumour, xanthoma, myeloxanthoma, myeloid endothelioma, granuloma, and round- and spindle-cell sarcoma, amongst other names. In 1923 Buxton attempted this classification: (1) Fibroma, chondroma, ganglion; (2) Sarcoma. There are several disadvantages in such a classification. The term 'fibroma' is applied to a definite type of growth of the fibrous connective variety, and though the tumour here referred to consists of fibroblasts, many of these are specialized and give the neoplasm a distinctive microscopical picture. Similarly the term 'chondroma' in itself gives but an inadequate conception of the growth. Little need be said concerning the term 'sarcoma'. The sarcomata have in recent years gradually been reduced from a numerically impregnable position, by the segregation of the 'sarcomata' of the testis, retroperitoneal tissues, mediastinum, etc., until now, with the exception of the osteogenic sarcomata, they comprise a decimated band which is viewed with considerable suspicion. No diagnosis is satisfactory, therefore, unless it is sufficiently complete to indicate the histogenesis and nature of a malignant connective-tissue neoplasm. Such terms as 'round-cell sarcoma' and 'giant-cell sarcoma' are not only futile, but are also treacherous, since they cause us to pigeon-hole a tumour whose origin is undetermined.

Since the type cell is distinctive, the term 'teno-synovioma' completely describes the growth. Multiplicity of terminology is to be deprecated, but in some departments of pathology we are without adequate or sufficient terms. Probably the term 'synovioma' is sufficient, since the growths arising

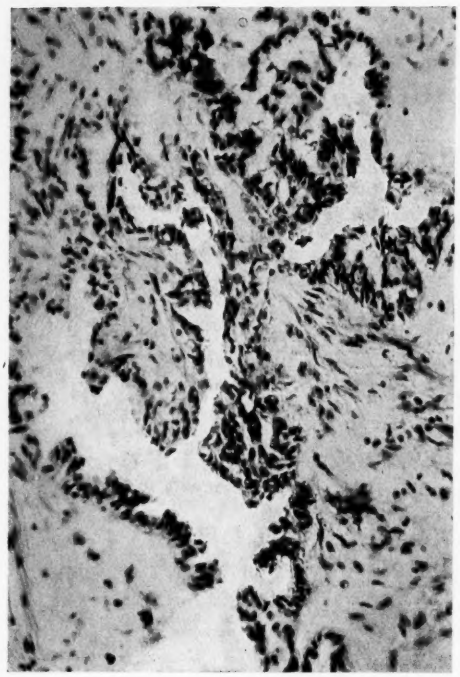

FIG. 463.—Another portion of the tumour shown in *Figs.* 461, 462. Such growths have been described as endotheliomata. (× 80.)

FIG. 464.—Higher-power view of cells lining the spaces in *Fig.* 463. Compare with cells lining the joint cavity in *Fig.* 472. (× 540.)

FIG. 465.—Photomicrograph of a section taken from a recurrent tumour. (× 80.)

FIG. 466.—Section showing an irregular space with atypical papillary projections in a malignant tendon-sheath growth. (× 80.)

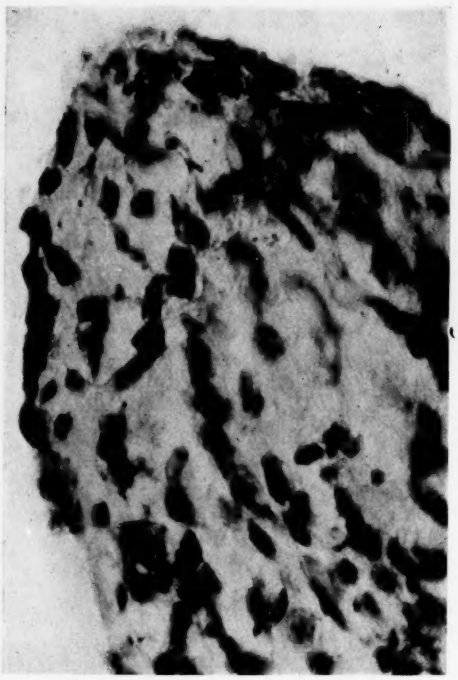

FIG. 467.—Higher-power view of the cells lining one of the projections shown in *Fig.* 466. (× 540.)

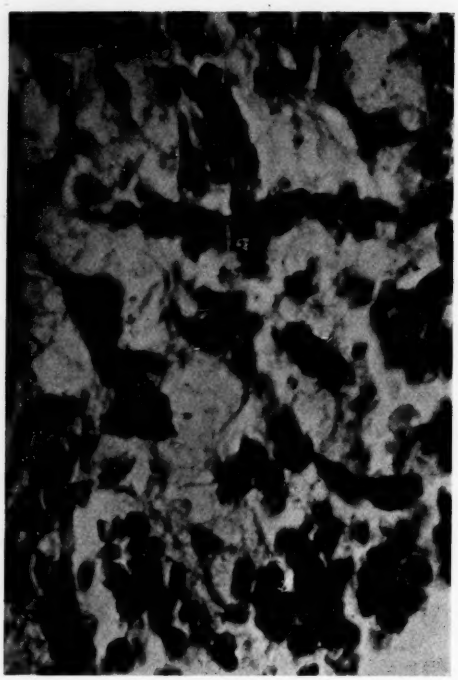

FIG. 468.—Photomicrograph showing the cells comprising the growth shown in *Fig.* 466. Compare them with those of the inflamed synovial membrane in *Fig.* 470. (× 540.)

FIG. 469.—Photomicrograph of a portion of synovial membrane, showing the cells lying either on the surface or embedded more or less completely in the connective tissue. (× 540.)

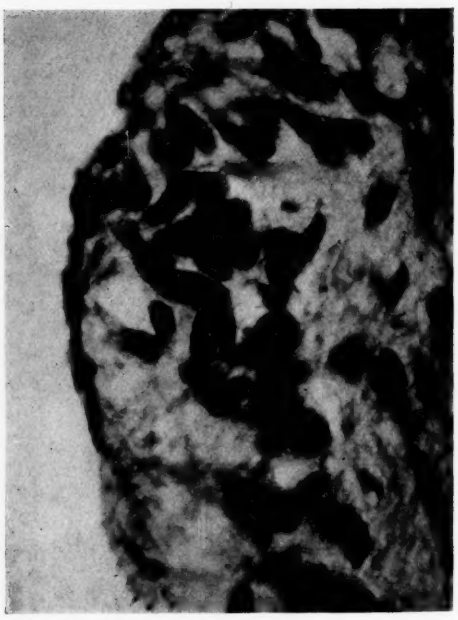

FIG. 470.—Section of chronically inflamed synovial membrane. The cells are spindle or spheroidal in shape, and do not line the surface as do endothelial cells. (× 540.)

in the synovial membrane of joints present certain similarities to these discussed. As I am, at the moment, without sufficient material to demonstrate this, the first term is here retained. It should be appreciated that this is not a suggestion that this term should be brought into general use, but is merely an attempt to bring certain of the special features of these growths into general notice. The classification suggested is :—

TENO-SYNOVIOMA—

Innocent :
Fibrous
Cartilaginous
Fatty
Vascular
Osseous
Mixed forms containing several of these tissues. These may be complicated by the presence of giant cells or foamy cells.

Malignant.

The giant cells and the foam cells require special mention. As previously stated, these cells have absorbed the attention of many investigators to the exclusion of all else. The giant cells are of the foreign-body variety. They have been shown to be associated in these growths with the presence of free cholesterol. Elsewhere, the association of giant cells with cell débris, material difficult of absorption, fatty material, etc., has been demonstrated frequently. There is no reason for considering that they have greater significance in this case than the absorption of degenerated material.

In any attempt to determine the histogenesis of these neoplasms it is imperative that we ignore these features which are incidental in the life-history of the growth. This is the more necessary since, previously, so much emphasis has been laid on their presence. In a similar manner, the foam cells must be regarded as incidental. They occur in many parts of the body where there has been injury or hæmorrhage, and the foam cells of tendon-sheath tumours are probably also such phagocytic cells. These foam or 'xanthoma' cells are the cause of the yellow colour observed in some of these growths. A band of yellow colour running through a tumour will be found to correspond microscopically to a band of tissue which consists of these cells.

The relationship of the tendon-sheath tumours to ganglion is another problem requiring elucidation. As shown in the description of the macroscopic and microscopic appearances, areas almost identical, as far as could be determined, with a ganglion were found in one of the tumours examined. The similarity extended even to the presence of millet-seed bodies. It would appear that a ganglion may arise as a tumour which has undergone mucoid change.

Is the condition inflammatory or neoplastic ? This is a question that has been asked many times. There are a certain number which are undoubtedly neoplastic, but some—particularly the giant-cell forms—are more difficult of interpretation. The xanthoma cells are very common in inflammatory conditions, and are unknown as composing a neoplasm. Giant cells also, of the foreign-body type, are evidence of tissue absorption—and hence destruction

FIG. 471.—Photomicrograph of a section showing synovial fringes from a case of osteo-arthritis. The character of the lining tissue is well shown. (× 80.)

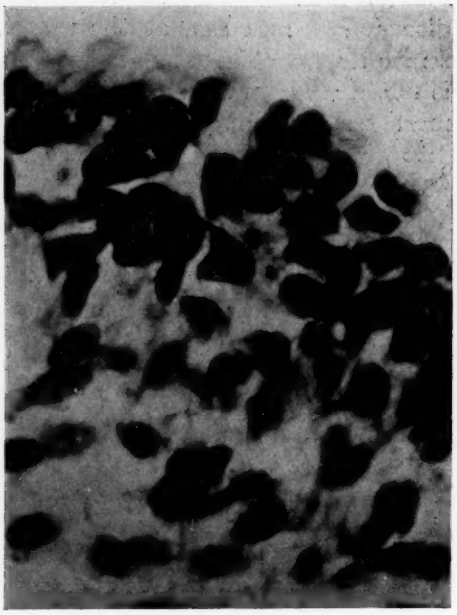

FIG. 472.—Photomicrograph of a portion of an inflamed synovial membrane. The cells are spheroidal in shape and do not lie on the surface. (× 540.)

FIG. 473.—Photomicrograph of a portion of a malignant tendon-sheath tumour. (× 80.)

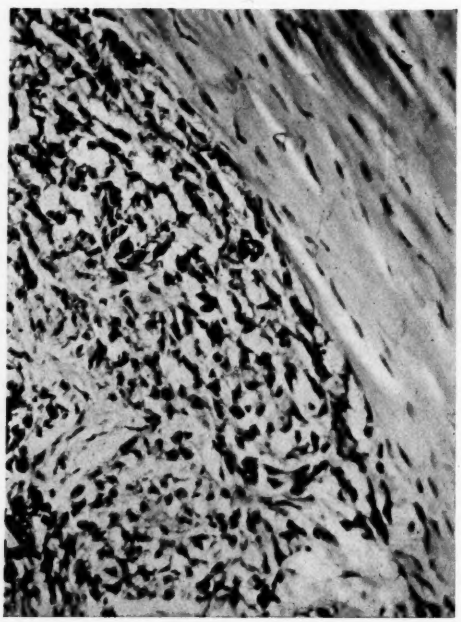

FIG. 474.—Photomicrograph of a portion of the growth shown in *Fig.* 442, showing the invasion of the tendon by the neoplasm. (× 160.)

FIG. 475.—Photomicrograph of a portion of a tendon-sheath tumour showing the curved line of 'condensation' of the cells, which is thought to occur prior to the formation of a cavity. (Cf. with *Fig.* 476.) (× 80.)

FIG. 476.—Another portion of tissue from the same tumour as shown in *Fig.* 475, showing the formation of a 'synovial' space. (× 160.)

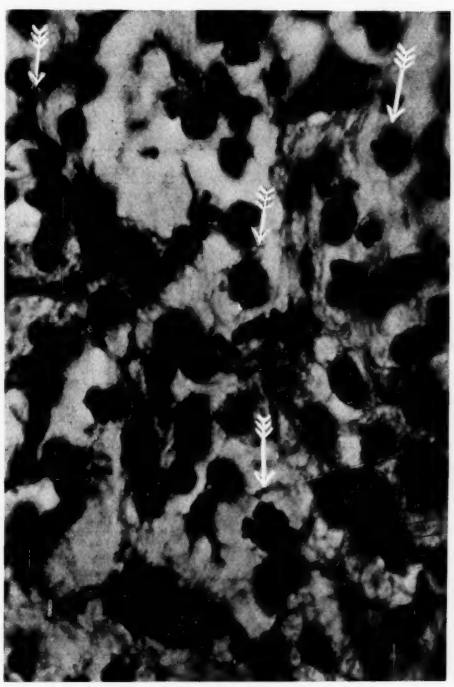

FIG. 477.—Photomicrograph of a portion of a tumour which closely resembled a ganglion. Note the number of mitotic figures—indicated by arrows. (× 720.)

—and usually indicate an inflammatory process. The history of trauma in most cases suggests that the destruction of tissue may give rise to subsequent inflammatory reaction and growth. On the other hand, true new growths may arise after an injury, and, as stated, some of the tumours under discussion are undoubtedly neoplastic. Some of the tumours that I have examined, though showing evidences of chronic inflammation, possess so many mitotic figures in the cellular areas (*see Fig.* 477) that a neoplastic element seems certain. We may conclude, therefore, that some of the tendon-sheath tumours are certainly neoplastic, and others are lowly malignant or innocent growths with a superadded chronic inflammation.

The definite inflammatory conditions—e.g., chronic tenosynovitis—are beyond the scope of this paper. Dunn has suggested that the doubtful tumours are on the borderline between inflammation and new growth. Since there appears to be every gradation between the malignant metastasizing tumour through the innocent growth to the chronic inflammatory conditions, some will no doubt fall into this class. A brief consideration of the definition of neoplasia will prevent our being dogmatic on this subject. Most statements in our present state of knowledge must be a question of opinion.

SUMMARY.

1. Synovial membranes have a characteristic histological picture.

2. Tendon-sheath tumours may be interpreted in terms of this normal cellular structure.

3. 'Synovial spaces' in tumour tissue, and not the giant cells or xanthoma cells, are an important and characteristic feature.

4. Metaplasia, the formation of cartilage, and the occurrence of chondroma are discussed.

5. The relationship to ganglion is mentioned.

6. The views concerning the neoplastic and inflammatory origin of some of the growths are reviewed.

CONCLUSIONS.

Pathological conditions are to be explained in terms of the characteristics of the tissues in which they arise.

Tumours of tendon-sheaths arise from the cells of the synovial membrane of the sheath, and the morphology and nature of the growths depend on the potentialities of the originating cells.

Classifications of these growths should embody this principle.

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THE TREATMENT OF CEREBRAL TUMOURS WITH RADIUM.*

By J. PATERSON ROSS, London.

(Being a Hunterian Lecture delivered at the Royal College of Surgeons of England on January 28, 1931.)

The treatment of intracranial tumours by any method at present conceived presents certain problems peculiar to this field of surgery. There are difficulties of diagnosis, both anatomical and pathological; difficulties of access; and complications which arise from sudden changes in tension within the dural capsule, with resultant alterations in the circulation and damage to the cerebral tissue. Gradually these problems have been defined and tackled, and modifications in technique have been introduced to improve the methods of approach to the brain, to obviate dangerous changes in intracranial tension, to reduce the risk of infection to the minimum, and to control hæmorrhage. The recent adaptation of electrosurgical methods, the exact value of which is at present difficult to estimate, has been acclaimed the most notable advance in surgery since the introduction of antiseptics.

Technical advances have led to fresh discoveries in regard to the pathology of brain tumours, and have rendered possible and successful procedures which before the beginning of the present century would have proved too hazardous. This applies especially to the treatment of encapsulated tumours, but in the case of the gliomas it must be confessed that attempted removal, although carrying a much lower immediate mortality-rate than formerly, gives but a small chance of ultimate cure. Seeing that, if pituitary tumours be excluded, the glioma group constitutes over 70 per cent of the primary brain tumours verified by operation, the outlook is rather discouraging, and the hope has been expressed that radiotherapy might succeed where surgery has failed. The present studies have been undertaken to try to discover how far this hope is justifiable. The investigation is confined to the glioma group, though there are many recorded observations in regard to irradiation of endotheliomas, pituitary tumours, and neurofibromas.

PATHOLOGICAL CONSIDERATIONS.

In order to understand the problem of the gliomas it is necessary to make a brief reference to their pathology. Of the many criteria which indicate the malignancy of a tumour, the most important is the character of the neoplastic cells, and especially the degree to which they are differentiated. The more embryonic and undifferentiated the cells, the more active is the growth and the more malignant the tumour; and there is evidence that the

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degree of differentiation may vary during the life of a glioma, the tendency being towards de-differentiation (Bailey). Guided by this histological feature, it is possible to grade the gliomas according to their malignancy, although they all infiltrate the brain and none disseminates by the lymphatic or blood-stream.

At an early stage in the development of the nervous system from the embryonic epiblast two main types of cell are distinguishable—the primitive spongioblast and the germ-cell. From some of the primitive spongioblasts the ependyma is derived, and the remainder eventually become the astrocytes of the adult neuroglia. The astrocyte has multiple processes which can be demonstrated by gold staining methods, and one of these processes is thicker and longer than the others and is attached to the wall of a blood-vessel, where it is flattened out into a small end-plate known as a 'sucker foot'. The supporting tissue of the nervous system may be regarded as a network formed of the processes of the astrocytes stretching across from vessel to vessel. The germ-cells give rise to neuroblasts which develop into nerve-cells, and to medulloblasts.

The gliomas have been separated by Bailey and Cushing[1] into thirteen histological groups, but in their large series they found that between 35 and 40 per cent were astrocytomas, 35 per cent spongioblastomas, and 13 per cent medulloblastomas, these three groups thus accounting for about 85 per cent of the verified gliomas. Carmichael,[2] analysing a smaller series, also found that almost all the gliomas belonged to these three groups, but that the proportion of spongioblastomas to astrocytomas was considerably greater.

Astrocytomas are composed of cells which resemble closely the adult astrocytes, having an affinity for gold stains, and each cell possessing one long process attached to a vessel by a 'sucker foot'. The tumour appears as a white, firm area, and, having no recognizable edge, it often looks like an enlargement of the white matter of the brain. Not uncommonly the tumour substance becomes liquefied, and a gliomatous cyst is the result. The blood-supply of the tumour is but slightly richer than that of the neighbouring brain, which shows no reactionary gliosis. Growth is slow, and it has been estimated that the average duration of life after signs of tumour formation have appeared is twelve to eighteen months, though it may be considerably longer. There is evidence that certain of the astrocytomas can recur in a more malignant (de-differentiated) form after partial removal.

The spongioblast is a much less differentiated cell than the astrocyte, possessing only one or two short processes which never show a 'sucker foot'. Spongioblastomas are soft tumours, usually reddish in colour owing to their great vascularity and to old and recent hæmorrhages. They seem to have a well-defined margin, and often give a deceptive appearance of encapsulation. Sometimes the majority of the tumour cells may be recognized as spongioblasts, but more commonly the growth consists of a mass of embryonic cells varying greatly in size and shape, and taking gold stains poorly. The peripheral portions of the tumour are cellular, the central degenerate, and what appears macroscopically to be the capsule is seen to be in reality a thin dense layer of growth enveloping a mass of degenerate tissue. The tumour is surrounded by a well-marked zone of gliosis and œdema.

These rapidly growing neoplasms are the so-called gliosarcomas of the older literature (a misnomer due to ignorance of the ectodermal origin of the neuroglia), whose early recurrence after 'enucleation from the capsule' is now recognized as continued proliferation of rapidly growing cells which form the layer mistaken for a capsule. They are usually fatal within about six months of their recognition.

Seeing that these tumours have given rise to so much speculation, it is interesting to try to discover what John Hunter thought about them nearly a hundred and fifty years ago. That he observed them there is no doubt; and the specimen of a cystic spongioblastoma in the Museum of the Royal College of Surgeons (No. 5030–1) is probably the preparation referred to as a hydatid in the brain in lectures delivered by Sir Everard Home "chiefly from Mr. Hunter's notes". The term 'hydatid' signified merely a cyst, and in the lecture notes it is stated that hydatids form in the brain of the human subject. This occurred in a lady in London who had violent and distressing headache, and this increased almost to madness. The pain came on periodically, so that the cause could not be made out, as the symptoms were not like those of depressed brain. She died, and on examining the brain a hydatid was found, of a globular shape and of the size of a common orange.

It would appear that Hunter confused the solid spongioblastomas with chronic abscesses, though he was not satisfied that the appearances accorded with the picture of inflammation. In the *Treatise on Inflammation* he writes: "Chronic inflammation is much more frequently attended with increased vascularity at first, but—as the brain becomes softened—with a red, yellowish, or whitish colour, marking three several kinds of mollescence, depending on the effusion of blood, pus, or serum. There seems reason, however, for believing that this pulpy disorganization of the brain may take place independently of inflammation. The most remarkable circumstance with this tissue is the occurrence of large chronic abscesses, generally enclosed in thick cysts and unattended with any symptoms during life. These I have known to occupy one entire hemisphere of the brain. Ulceration sometimes occurs towards the surface of the convolutions, and by some the diffluent state of the brain before spoken of is thought to resemble mortification."

The medulloblastomas are tumours consisting of still more primitive spheroidal cells without processes. They occur chiefly in children, and always in the cerebellum or its immediate neighbourhood, and their clinical history is very brief. They are very vascular, and owing to the extreme rapidity of their growth they soon break through the covering pia mater and give multiple deposits in the subarachnoid space which have been referred to in the past as 'sarcomatosis of the meninges'.

RESULTS OF SURGICAL TREATMENT.

What has surgery to offer in the treatment of the gliomas? Even in the case of the astrocytomas it is clear that it may be impossible to remove the tumour entirely unless one is prepared to sacrifice some of the surrounding brain tissue as well, and in spite of the controversy over cerebral localization, there are few areas of the brain which we are justified in regarding as

unimportant and which may be removed with impunity. When an astrocytoma is cystic, it is often possible to find, after evacuation of the cyst, a nodule of tumour which can be removed apparently completely. Even in such cases it is impossible to foretell what may happen: some recur as solid, more de-differentiated tumours, but others have been followed up for years and remain apparently cured. The average duration of life after operation on an astrocytoma is about five years. The spongioblastomas and medulloblastomas, however, have characters which render their complete removal practically impossible. By electrosurgery better results may be obtained, but at present the average survival period after operation on a spongioblastoma is under one year, and in the case of a medulloblastoma it is still shorter.

Statistics published from the best-known clinics show that operations upon the gliomas carry a post-operative mortality-rate of between 20 and 25 per cent. Of the patients who recover from the operation, nearly 70 per cent are unlikely to live for a year, and rather less than 25 per cent make a prolonged and good functional recovery. Small wonder that the neurological surgeon should search for a method of improving these results!

POSSIBILITY OF ATTACK BY RADIUM.

The outlook in tumours of other organs has been improved during the past few years by modifications in radium technique, and this prompts one to use similar methods for tumours of the brain. Two questions immediately call for an answer—Is it likely that radium will have any effect on glioma cells? and—Will the dose of radium likely to affect the tumour cells destroy healthy cerebral tissue?

A good deal of study has already been devoted to the effects of X rays upon cerebral gliomas. Many conflicting reports have been published, the growth of some tumours being arrested while others seemed to be unaffected by the treatment. The fullest account has been contributed by Bailey and Sosman[3] from Cushing's clinic, and investigations on similar lines from other centres[4] agree with their conclusions. In all their cases an operation was performed and an attempt made to remove the tumour, the nature of which was thus identified; and their results show the value of X-ray treatment as an adjuvant to operation. They believe that life was prolonged considerably in many patients with medulloblastomas, and in a certain number who had spongioblastomas, though in the latter group hæmorrhage not infrequently took place into the tumour, owing, it is supposed, to the damage done by the rays to the poor blood-vessel walls. The survival period of the astrocytomas was not prolonged at all, and many of the patients seemed to be made worse by the treatment. The general result of these authors' investigation was to confirm Ewing's prediction that the tumours with the more embryonic type of cell would react more favourably to irradiation. Ewing[5] goes so far as to say that the gliomas present most of the structural features which favour susceptibility to radiation, being cellular tumours whose cells are delicate, whose blood-vessels are numerous and fragile, and which frequently show hæmorrhage and necrosis. In his opinion only the astrocytoma contains anything like a resistant intercellular material, and this is usually

poorly formed and scanty; and he concludes that he knows of no tumour which on *a priori* grounds ought to yield more readily to moderate radiation than the average glioma.

It seems reasonable to suppose that radium should have an effect similar to that of X rays.

EFFECTS OF RADIUM ON NORMAL CEREBRAL TISSUE.

Assuming the use of radium to be reasonable, especially in gliomas composed of cells of the more embryonic types, the more important question of injury to the surrounding brain substance by radium has to be considered. Experimental work on this subject began nearly thirty years ago. The early workers employed large doses of unfiltered rays applied for a short time, using, as a rule, small animals. Hæmorrhage into the irradiated brain substance was the constant result, the severity of the lesion varying as the dose, and inversely as the age of the animal. They concluded that the effect of radium on the brain was to damage the blood-vessels without producing marked change in the nerve-cells, but it must be remembered that these changes may have been due largely to β rays. Such experiments with some modifications have been repeated recently by Bagg,[6] Pendergrass,[7] and others, and similar results have been obtained. The greater part of the experimental work recorded is not of direct value to the surgeon, since dosage and filtration are inadequately described, or have been quite out of proportion to what would be used in surgery. Horsley and Finzi[8] used well-filtered radium, but, as was then the custom, they applied a large dose of radium for a short time—55 mgrm. of radium bromide for two and a half to four hours. Though previous workers had produced paralysis in some of their animals, those operated upon by Horsley and Finzi showed no symptoms, probably because they were excluding almost all the β rays. The animals were killed from two to six weeks later, and the cortex and meninges showed hæmorrhage, thrombosis of vessels, and infiltration of the perivascular spaces. In the thrombotic area the neuroglia was vacuolated and the nerve-cells had disappeared, but any changes in the nerve tissue were believed to be secondary to the vascular lesions. In recent years it has become the practice when treating tumours in other parts of the body to use smaller, more widely distributed doses of radium for longer periods. Bagg had shown experimentally that a small dose of unscreened radon acting for a long time gives a small lesion in the brain, whereas the same dose given as a large quantity of radon acting for a short time caused widespread destruction of cerebral tissue and was often fatal.

E. A. Carmichael and I have carried out a series of experiments to try to discover what the effect would be upon normal brain tissue of well-screened radon and radium applied in doses comparable with those used for the treatment of tumours elsewhere in the body. For the experiments rabbits have been used, and the sources of irradiation have been radon seeds filtered by 0·3 mm. of platinum, radon seeds filtered by 0·5 mm. of platinum, and radium needles containing 0·5 mgrm. of radium filtered by 0·6 mm. of platinum (*Fig.* 478). Under ether anæsthesia an incision is made through the scalp, and the

bone is removed, working forwards from the ridge between the supra-occipital and parietal bones, till an area of dura about 1 by 0·5 cm. has been exposed about 1 cm. from the mid-line. In the early experiments the dura was then incised and the filtered seed placed on the cortex; but in the majority the seed has been placed on the intact dura so as to diminish the risk of wounding the brain. Control experiments with empty platinum containers have been carried out from time to time, and in none has any change been found in the brain. Our first object was to produce a lesion which could be attributed only to irradiation. Therefore doses much larger than the therapeutic dose were used, in the hope that the study of such lesions would indicate what changes should be looked for when therapeutic doses were applied. Twenty-eight experiments have been done with large amounts of radon, the duration of the application and the filtration of the seeds being varied. The average strength of the seed at the time of insertion has been 5 mc., and in sixteen cases the seed was filtered by 0·3 mm. of platinum and in twelve by 0·5 mm. of platinum. The animals have been killed with ether at periods from 3 hours to 170 days after insertion of the radon, and after marking the position of the seed with indian ink the brain has been fixed in formol bromide. Sections have been stained by the following methods: (1) Silver stain for microglia (Del Rio-Hortega); (2) Scharlach R for fat (Herxheimer); (3) Gold for astrocytes (Ramon y Cajal); (4) Bielchowsky (da Fano's modification) for neurofibrils; (5) Weigert-Pal for myelin; (6) Toluidine blue (Nissl) for nerve-cells; (7) Hæmatoxylin and eosin; (8) Hæmatoxylin and van Gieson.

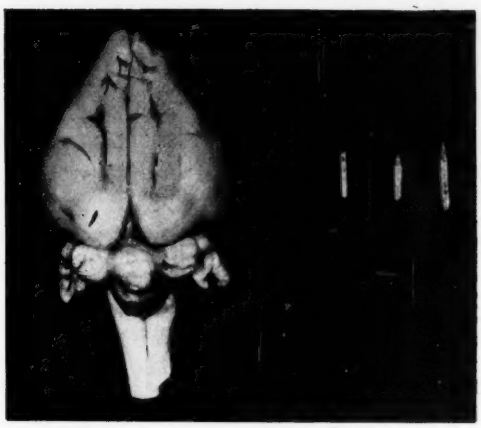

FIG. 478.—To show relative sizes of a rabbit's brain, two radon-seed containers 0·3 mm. and 0·5 mm. in thickness, and a radium needle with 0·6-mm. wall.

Ten Experiments, using Radon Seeds 5 mc., filtered by 0·5 mm. Platinum, applied for 3 to 24 Hours.—The brains which were irradiated for less than twenty-four hours showed no macroscopic changes. Under the microscope, however, vascular congestion was noted after three hours; after six hours fatty degeneration appeared in the endothelium of the blood-vessels, and the irradiated tissue stained poorly, showing as a pale wedge-shaped area with its base on the surface. These changes were more marked by the ninth hour, and swollen microglia cells were visible. At the end of sixteen hours a wider and deeper area of the cortex was involved, and around several of the blood-vessels an extravasation of polymorphonuclear leucocytes was present. After exposure for twenty hours the cortical vessels were congested and there was a cellular infiltration of the meninges. Leucocytes were present in large numbers in the superficial part of the cortex, and there was a well-defined area in which the brain substance appeared necrotic, and was infiltrated with

microglia cells loaded with fat. Surrounding this patch of necrosis was a zone in which the nerve-cells failed to stain for neurofibrils, and the myelin sheaths were becoming swollen and disintegrated.

Previous workers had considered that any changes in the brain tissue proper following irradiation were secondary to hæmorrhage or thrombosis of the cerebral vessels. It must therefore be noted that in the present experiments, although the earliest changes were seen in the vascular endothelium, definite evidence of an effect on the nervous elements, presumably destructive, preceded hæmorrhage or thrombosis.

After irradiation for twenty-four hours a small purplish area was visible close to the seed, and microscopic examination revealed multiple hæmorrhages extending to a considerable depth beneath the surface. The area of pallor was still visible.

The degeneration of the vascular endothelium produced by radium is of very great importance in the treatment of tumours. Some tumours are not only very vascular, but their vessels are thin-walled and poorly supported by the soft tumour substance, and the accident of hæmorrhage into the tumour following irradiation is readily explained.

Twelve Experiments, using Radon Seeds 5 mc., filtered by 0·3 mm. Platinum, applied for 3 to 170 Days.—Two of these were control experiments. In one rabbit a platinum container without radon was placed upon the dura and left for 118 hours. No macroscopic lesion was to be seen, and microscopic examination revealed no changes in the blood-vessels or brain-cells. In the second control experiment the rabbit died under the anæsthetic just after the seed (5 mc.) had been placed. The seed was left in position for twenty-four hours and then the brain was removed. On examination no lesion was found—a result which is only to be expected considering that the lesions are manifestations of vital tissue reaction.

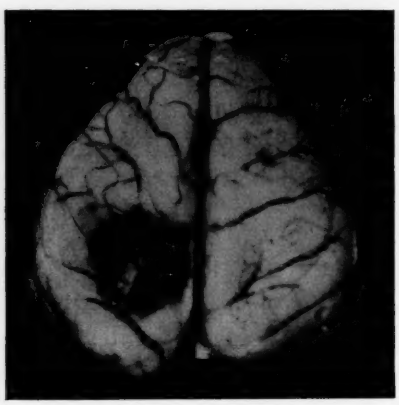

FIG. 479.—To show hæmorrhage produced by 5-mc. radon seed, filtered by 0·3 mm. platinum, applied for 5 days.

The other ten animals were killed after the radon had been in position for 68 hours, 94 hours, 118 hours, 143 hours, 212 hours, 40 days, 47 days, 54 days, 61 days, and 170 days. After 68 hours an obvious lesion had been produced. There was no intradural blood-clot, but the cortex was plum-coloured for a distance of 2 mm. around a central white streak corresponding to the position of the seed (*Fig.* 479). Section of the brain showed that the discoloration extended for 3 mm. into the brain substance. As the time of exposure was increased up to 212 hours the zone of discoloration increased in size till its diameter measured 8 mm., and the dura became more and more adherent to the damaged cortex. Under the microscope the white area proved to be a mass of necrotic tissue infiltrated with microglial cells loaded with fat. The plum-coloured zone showed multiple small hæmorrhages which after irradiation for 68 hours

extended to the white matter, but after more prolonged irradiation reached the lateral ventricle, and after 212 hours were to be seen even on the far side of the ventricle (*Fig.* 480). All specimens showed fatty changes in the endothelium of the blood-vessels, and after 94 hours thrombosed vessels were found. Microglial cells containing fat were present in the perivascular spaces around the lesion, and were to be found in the subarachnoid space at a considerable distance from it. In the zone surrounding the necrotic area the nerve cells stained poorly, the neurofibrils being fragmented; the astrocytes were becoming disintegrated; and farther away from the lesion the myelin sheaths stained more faintly and showed some segmentation. The actual size of the lesion increased gradually until the 212-hour period, by which time the radon had become almost inactive.

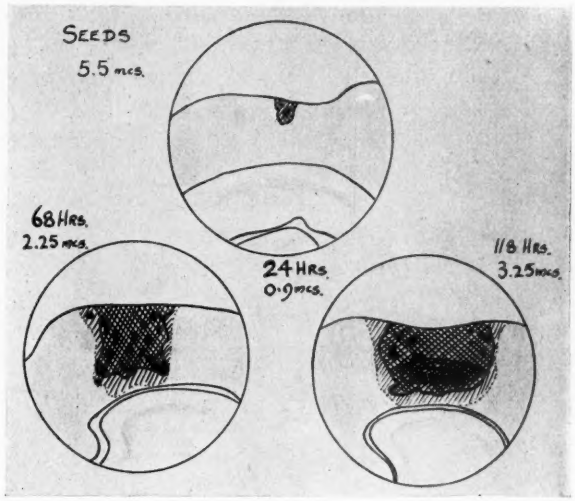

FIG. 480.—Drawings to scale to show the increase in extent of hæmorrhage and necrosis with increase in period of action of radon seed.

When a long period—40 to 170 days—was allowed to elapse before the brain was removed, the purplish area was seen to be replaced by a yellowish-white core of necrotic material surrounded by a narrow ring of a deep pink colour (*Fig.* 481). Microscopic examination proved the central mass to be necrotic, infiltrated with microglia cells, and walled-in by a ring of proliferating astrocytes which are evidently taking part in the process of repair. As time went on the central necrotic mass became smaller and smaller and the astrocytes more numerous (*Fig.* 482). It must be noted that irradiation can give rise to the formation of astrocytes, and it would therefore be unlikely that irradiation would have a destructive effect on the tumours of which the cells resemble most closely the astrocytes—namely, the astrocytomas. This agrees with the therapeutic results obtained up till the present time.

FIG. 481.—White indurated area of necrosis resulting from application of 5-mc. radon seed, filtered by 0·3 mm. platinum, for 47 days.

It must be concluded from this series of experiments that a large dose of radon can produce a local necrosis of cerebral tissue associated with hæmorrhage; that this process is limited to

parts within a radius of 5 mm. from the seed; and that destruction continues for about 212 hours, being followed by a process of repair. That increasing the filtration diminished the amount of destruction of brain tissue is shown by comparing the lesions produced by the same dose of emanation (3·2 mc. destroyed) from two 5-mc. seeds, one platinum container being 0·3 mm. thick and the other 0·5 mm. thick (*Fig.* 483).

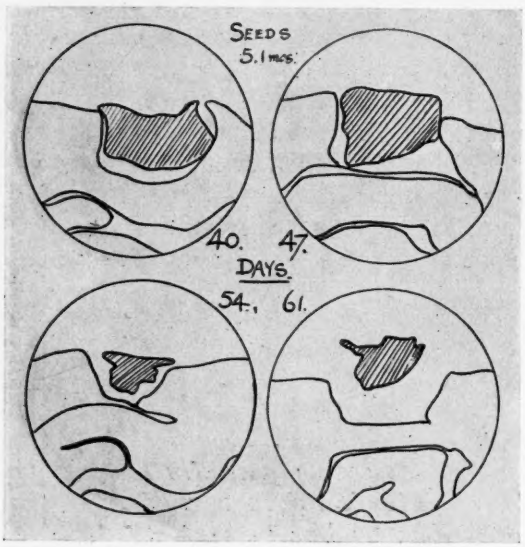

FIG. 482.—Drawings to scale to show areas of necrosis resulting from application of 5-mc. radon seeds for periods of 40, 47, 54, and 61 days.

It must be understood that all the results described so far were produced by very large doses of radon; the effect of therapeutic doses will be described later. The strength of the most powerful seed inserted was 16 mc., and after 116 hours this had produced the only subdural hæmatoma in the series, and the area of discoloured and friable cortex was 1 cm. in diameter. The animal, however, showed no sign of involuntary movement or paralysis, and did not appear to suffer at all from this enormous dose. The situation of the lesion probably accounts for this absence of symptoms; for it has been shown by Cairns and Fulton,[9] again using radon in amounts greatly exceeding the therapeutic dose, that, when applied to the spinal cord of cats, large doses of emanation may produce paraplegia. A large area of the cortex may be destroyed without producing the harmful effects of a small lesion in the conducting paths of the spinal cord.

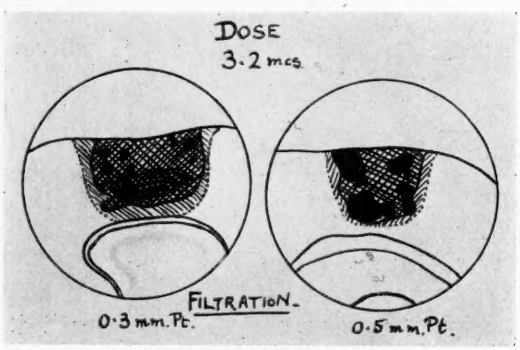

FIG. 483.—Drawings to scale showing effect of the same amount of radon filtered by 0·3 mm. and 0·5 mm. of platinum.

Seven Experiments, using Radon Seeds 1·5 mc., filtered by 0·5 mm. Platinum, applied for 5 to 21 Days.—At the end of seven days there was no macroscopic lesion, and histologically there was no clear evidence that any damage had been done. After fourteen days there was a faint blush just beneath the seed, but no macroscopic hæmorrhage. Sections showed tiny superficial hæmorrhages, fatty changes in the walls of the blood-vessels in the immediate vicinity of the seed, and swollen microglia cells containing fat migrating laterally over

the surface of the brain. The microglia cells and the astrocytes close to the seed were poorly stained, and the processes of the latter were swollen and fragmented, but there was no massive necrosis. No further changes were found after twenty-one days. From these experiments it may be concluded that radon in the strength used therapeutically in other regions produces changes in cerebral tissue which, though of a destructive nature, are not severe enough to contra-indicate the placing of such radon seeds in the questionable, possibly healthy, area around a brain tumour.

Twelve Experiments, using Radium Needles Containing 0·5 mgrm., filtered by 0·6 mm. Platinum, applied for 3 to 58 Days.—The effect of the radium salt itself, distributed so that there is roughly 1 mgrm. of the element for every centimetre active length in platinum needles 0·6 mm. thick, is even less damaging to the rabbit's brain tissue than radon, for in ten out of twelve brains irradiated hæmorrhage did not occur, and in the remaining two it was visible only under the microscope, very minute extravasations having taken place. There were, however, quite definite changes close to the needle, giving clear evidence of a direct action of radium on nerve tissue independent of hæmorrhage.

In a series of nine animals the time of application of the radium needle was increased gradually from three to fifty-eight days. No change was found until the end of a week, when a poorly-stained area was seen around the position of the needle, the nerve elements apparently being more affected than the astrocytes, which stained well. By the end of a fortnight these changes were better marked and extended over a wider area, and fatty changes in the vessel walls, and microglia cells loaded with fat, were visible in the lesion. Even after the longest periods of irradiation the most marked feature was poor staining, indicative of necrosis of the tissue close to the needle, but there were no hæmorrhages—some of the vessels may have been thrombosed, but the evidence of this was indefinite—and the astrocytes were proliferating around and even within the lesion.

FIG. 484.—Proliferation of astrocytes around lesion produced by extradural application of radium needle for 21 days, animal being killed 3 months after removal of radium.

Three animals were treated for twenty-one days and the radium was then removed. The animals were killed four weeks, six weeks, and three months after removal of the radium. These brains showed the destructive lesion of the cortex quite distinctly, and at the site of the lesion the cortex was thinned, and densely infiltrated with astrocytes (*Fig.* 484), forming a scar adherent to the dura, and drawing the deep layers of the cortex and the tracts towards the surface.

It may be concluded from these experiments that radon seeds of 1·5 mc. filtered by 0·5 mm. platinum, or needles containing 1 mgrm. of radium element per centimetre active length filtered by 0·6 mm. platinum, acting for seven to fourteen days, have an effect which, though destructive in nature, does not cause serious damage to the cerebral cortex of the rabbit. There is no reason to suppose that such concentrations of radium or radon suitably distributed would be more harmful to human cerebral tissue. It must be noted, however, that one of the results of irradiation is proliferation of astrocytes, a reaction which looks like a response to injury. It may be that some gliomas are a form of reaction to injury. Whether this is so or not, it would appear unreasonable to expect radium to have a beneficial effect on the gliomas the cells of which approach the astrocyte in type.

METHODS OF USING RADIUM.

Having determined as far as possible the dose of radium which may be employed with safety, the next problem concerns the possible methods of applying radium to a cerebral tumour. It must be understood that the blind application of a large dose of radium to the surface of the head in the vicinity of a tumour is unjustifiable. In all cases an attempt must be made to find the tumour and to remove it as far as possible, or at least to determine its nature. A decompressive defect is then to be left in the skull.

If radium is used blindly, a certain number of removable tumours, cysts, and other conditions which yield to surgical attack and will not respond to irradiation may be overlooked. Also radium, in common with X rays, causes an initial congestion and swelling of the brain tissue, which, unless a decompression opening is present, may produce serious or even fatal complications. Operation is therefore the first step, and the further possibilities are :—

1. *Implantation* : (*a*) Implantation of a large dose of radium in the centre of the tumour; (*b*) Barrage by multiple small sources of radiation surrounding the tumour.
2. *External application.*

1. Implantation.—

a. Implantation of a Large Dose into the Tumour.—At first sight this might appear to be the best plan, for theoretically the radium would destroy the cells of the tumour in its immediate vicinity, and if the tumour were not too large, the outlying parts would stand a good chance of being irradiated also. But a large dose can be left in position for only a short time, owing to the risk of hæmorrhage ; and it was formerly the practice to insert 50 mgrm. of radium, heavily filtered, and leave it in position for twenty-four hours. It is now recognized that as a rule the brief application of a concentrated dose of radium is an inferior method of irradiating neoplastic tissue, and it has been abandoned. Occasionally brilliant results followed the use of radium even when so used, but it is doubtful whether the success was attributable to the radium or to surgery. Sir Percy Sargent has kindly permitted me to mention a group of cases treated some years ago by this method. The patients were followed up by Dr. Carmichael, and out of 22 only 3 were doing well—eighteen months, two years, and three years respectively after

operation. The remainder seemed unaffected by the radium, and it is questionable how far the radium was responsible for the successes. For these reasons Sargent altered his technique, and his present practice is described in a recent article in the BRITISH JOURNAL OF SURGERY.[10]

b. Multiple Foci Surrounding the Tumour.—This is the mode of attack which has proved most satisfactory in the treatment of tumours in other parts of the body. In the case of brain tumours radon seeds or radium needles may be employed. The advantage of radon seeds is that they may be left in position, whereas a second operation has to be performed to remove radium needles. On the other hand, if radium needles are used, it is likely that the irradiation of the area to be treated will be more uniform and complete. If this proves to be the case, then the more accurate distribution of radium in needles may give results which will justify the risk attendant upon a double operation.

Even though a brain tumour be radio-sensitive, the placement of radium so as to deal with it effectively may be a matter of great difficulty. The only satisfactory method of determining the extent of a tumour is to remove as much of it as possible. When this has been done the radium may be placed in the apparently normal brain tissue around the cavity which remains. It may be argued that if this course is followed it cannot be said that the tumour is being treated by radium. It is not to be expected, however, that a large tumour would be destroyed by surrounding it with radium ; and it is particularly in dealing with the invisible remnants of growth after 'removal', which produce the 'recurrences' after operation, that the action of radium is required. It must be clearly understood that at present the treatment of cerebral gliomas by radium alone cannot be considered ; radium can be used effectively only as an adjuvant to surgery.

This combined method of attack renders the estimation of the efficacy of radium extremely difficult, and it will not be known until patients have been followed up for some years, or until sufficient irradiated tumour tissue has been obtained post mortem. The problems that have to be considered are illustrated by the following cases which have been under the care of the Surgical Professorial Unit at St. Bartholomew's Hospital :—

A man, 36 years of age, had suffered for five years from epileptiform attacks involving mainly the left side of the body, and more recently had noticed that his left leg was growing progressively weaker. The fits were becoming more frequent and were associated with severe headache. Examination revealed evidence of a lesion of the right Rolandic area and bilateral papillœdema. On Nov. 1, 1928, an osteoplastic flap was turned down and the pre-Rolandic convolution was seen to be widened, and at its superior extremity a reddish mass of tumour was seen on the surface. The convolution was explored with a needle, the consistency of the brain was found to alter at a depth of 1½ cm., and on passing the needle further some yellow fluid was obtained. As it seemed unwise to run the risk of damaging this area of the cortex by exploring further, a portion of the tumour was taken for section, and seven radon seeds (2 mc. each, screened by 0·5 mm. platinum) were inserted. The man is now at work, two years after the operation ; the left leg is still weak, but the decompression opening at the base of the bone-flap is never tense, there is no papillœdema, and he does not suffer from fits. The tumour, however, was an astrocytoma protoplasmaticum, a glioma the life-history of which is believed to extend over many years, and we have not any evidence at present that the insertion of radon was of importance in relieving this patient's symptoms.

The fallacy of attributing the success of an operation to radium is illustrated by the following case :—

A woman of 52 for a year had been unsteady in gait, and for six months had frequently been unable even to sit up without losing her balance. She was found to have signs pointing to a lesion of the left side of the cerebellum, with internal hydrocephalus and papillœdema. The cerebellum was explored on June 15, 1928, and a vascular papilliferous tumour was discovered projecting between the left cerebellar tonsil and the side of the medulla. A fragment was removed for histological examination, and one seed containing 3·2 mc. of radon filtered by 0·3 mm. platinum was inserted. The tumour was a papilloma of the choroid plexus of the fourth ventricle. The patient made a steady recovery and was able to return to her household duties. In November, 1928, she was shown at a meeting of the Society of British Neurological Surgeons and was regarded as cured. In June, 1929, she returned with abdominal symptoms. The suboccipital region was not bulging, there was no papillœdema or headache, and there was no return of cerebellar signs. She died with multiple abscesses in the liver secondary to diverticulitis of the sigmoid colon. When the cerebellar region was examined post mortem there was only a fibrous nodule where the seed had been placed, but a much larger portion of the papilloma remained in the fourth ventricle. The operation had removed the obstruction in the circulation of cerebrospinal fluid, and although the radium had apparently dealt effectively with the portion of the tumour in which it had been placed, the relief of symptoms cannot be attributed to that.

Another case shows the difficulty of treating a tumour the outline of which cannot be determined, but it also affords important evidence of the efficacy of radium in arresting the growth of a tumour whose cells are of an undifferentiated type.

A man, 42 years of age, had suffered for eighteen months from attacks of vomiting, and nine months before admission to hospital had been compelled to give up his work because of giddiness. During the three months before admission to

FIG. 485.—Large portion of tumour, unsuspected at operation, filling fourth ventricle.

hospital in October, 1929, he had suffered from severe headache, and bradycardia had also been noticed. Examination revealed signs of a tumour in the cerebellum to the right of the middle line, and when this region was explored a dark reddish

tumour was found projecting from the fourth ventricle between the lower extremities of the cerebellar hemispheres. A small portion was removed for examination, and as the tumour was very vascular and was closely related to the medulla no attempt was made to remove it completely, but three radon seeds, 1·5 mc. each, screened by 0·5 mm. platinum, were inserted into what was considered to be the remains of the tumour. The patient did well for a time, but died four months after the operation. At autopsy there was no growth projecting downwards from the fourth ventricle, and at first it appeared that the radon had destroyed the growth. It had destroyed the portion which had been irradiated, but on cutting across the cerebellum an unsuspected mass of tumour was discovered growing from the roof of the fourth ventricle and projecting into it, thus obstructing the circulation of cerebrospinal fluid (*Fig.* 485). The tumour showed the structure of a medulloblastoma (*Fig.* 486); and it was possible post mortem to remove the seeds from the

FIG. 486.—Medulloblastoma. Section of tumour before insertion of radon seed.

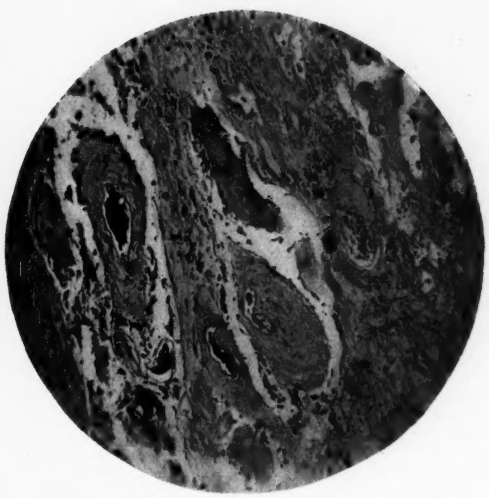

FIG. 487.—Medulloblastoma. Showing destruction of the tumour tissue and thrombosis of vessels close to the site of a radon seed.

specimen, mark their position with indian ink, and cut sections of the tissue which had been irradiated. These sections showed that the tumour cells had been destroyed in the zone immediately surrounding a seed, and at a greater distance the tissue failed to stain (*Fig.* 487). The effect was very limited in extent, however, and at a distance of about 1 cm. from the seed the tumour showed the characters of active growth.

The lesson to be learned from this case is that radium can destroy cells of this embryonic type, but that its action is purely local. As far as one could tell, there was little reaction in the surrounding tissues, and, although a few foreign-body giant cells were seen, no very active process or mechanism to remove the necrotic tumour cells was made out.

These are the only cases in which we have had an opportunity of examining irradiated tumour tissue. Another case illustrates the danger of hæmorrhage into the tumour after insertion of radium :—

A woman, 53 years of age, was admitted in coma with signs of a left hemiplegia. Her condition was improved by administration of hypertonic salt solution, and operation a week later revealed a tumour coming to the surface just behind the

central sulcus. A small portion was removed for examination, and ten radon seeds 2·9 mc. each, screened by 0·3 mm. platinum, were inserted. This was in May, 1928, when we were using seeds with more radon and less filtration than we use at present. Fourteen days later, after initial improvement, she suddenly became unconscious again, and the wound was re-opened. A large quantity of blood-clot was evacuated from the tumour and the wound was re-sutured. She returned to her home in the country six weeks later, was able to walk to the doctor's house every day for massage, and mentally she was normal. Six months later, however, symptoms began to return, and she died just over a year after operation.

2. External Application.—Following a decompression operation, radium may be applied externally on a helmet of Columbia paste, plastic wood, or rubber, and this method has been favourably reported on. Some patients so treated have shown improvement greater than that to be expected from decompression alone, and cases have been recorded in which a hernia cerebri has diminished in size or disappeared. It must be remembered, however, that radium has an inhibitory action on the choroid plexuses, and the mere recession of a hernia or the relief of symptoms is far from being evidence that the radium has destroyed a glioma. This method may be used when a tumour has been located but cannot be removed, when implantation presents insuperable difficulties or undue risk, or as a prophylactic measure after removal of a superficial tumour. To treat a deep tumour a large dose of radium is required, and, unless great care is exercised, the intervening tissue may be severely damaged. It is questionable whether this method possesses any advantages over X-ray therapy.

I have only once used external application, in the case of a boy 8 years of age who was found to have a spongioblastoma multiforme deep in the left lobe of the cerebellum involving the left side of the pons. Knowing the results obtained by Cairns and Fulton (referred to above), I did not like to insert radon seeds for fear of damaging the long tracts in the pons, though it must be remembered that they used very large doses of emanation in their experiments, and I think seeds of 1·5 mc. would probably be safe. However, having removed as much of the tumour as possible, I closed the wound, and when it was soundly healed radium was applied on a cap of spongy rubber, a total dose of 19,850 mgrm.-hours being given over a wide area. Before operation the child had been semiconscious. He improved rapidly, and was able to walk steadily in six weeks, and on discharge the only remaining signs were weakness of the left VIth and VIIth nerves. He remained well for five months, and, considering the severity of the condition, we were inclined to attribute the improvement largely to radium. But a sudden relapse, accompanied by signs of further involvement of the pons, suggestive of hæmorrhage into a still active tumour, makes one wonder whether the radium had anything to do with the temporary improvement.

Several articles dealing with radium treatment of the gliomas have appeared during the past ten years, but there are very few accounts of series of cases which would help to assess the value of any one method. In America Frazier and Pancoast were among the earliest workers in this field. Frazier is quoted[11] as saying in 1926 that, of 125 posterior-fossa tumours treated by irradiation he was unable in a single case to rule out operative procedures as responsible for the clinical results. Pancoast,[12] comparing radium and

X-ray therapy, says that he has an idea, based upon experience, that radium acts a little more favourably on brain tumours than does the roentgen ray. Hyslop and Lenz,[11] however, give it as their opinion that high-voltage X ray is better than the radium 'pack' for lesions more than 5 cm. from the surface; but their clinical records show only a small proportion of cases permanently benefited.

Sargent and Cade[10] have given an account of their experiences with implantation and surface application of radium, but, though some of the astrocytomas treated by them remain well, their paper gives no clear evidence of good results with the spongioblastomas. Cairns[13] has treated twenty cases of intracranial tumour, mostly spongioblastoma multiforme, with radium during the past three years. In his early cases he inserted radon seeds through the decompressive bone defect after effects of raised intracranial pressure had passed off. He abandoned this method on account of the difficulty of distributing the seeds uniformly through the tumour, and practised direct implantation of seeds under vision. This method he considered dangerous in cases of spongioblastoma multiforme, because of risk of hæmorrhage into the remains of the tumour; and recently he has been collaborating with Cade in the use of surface applications. He believes that it is too early as yet to come to any conclusions, but that there is good evidence that radium has a distinct beneficial effect in some of the malignant gliomas in which surgical methods alone have hitherto given such poor results.

SUGGESTIONS FOR FUTURE PRACTICE.

It must be admitted that on the whole the radium treatment of the gliomas has so far been unconvincing or even disappointing; but sufficient work has not yet been done to warrant the expression of a final opinion. Before that is possible cases will have to be more accurately grouped, both as regards the nature of the tumour and the mode of application of the radium.

Whenever possible a tumour should be removed, and when its extent has thus been determined, radium needles should be inserted around the tumour so as to irradiate the surrounding cerebral tissue evenly and completely, the needles being removed about ten days later. If the tumour is irremovable or its extent cannot be determined, an attempt should be made to excise a fragment for histological examination, and then either radium needles may be inserted where the edges of the tumour are believed to be—as determined by alterations in the consistency of the tissue—or radium may be applied on the surface. In such cases, however, and in the case of deep tumours localized by physical signs or ventriculography but not seen at operation, I am doubtful if much is to be expected from radium, and I am inclined to favour X-ray treatment.

In course of time, records of the partially removable tumours treated with radium by a uniform technique will enable us to say whether radium can deal with gliomas of a certain pathological type or not. At present we may say: (1) That we believe that radium in the dosage suggested above may be inserted harmlessly into the brain; and (2) That we believe that at

all events the majority of the gliomas should respond to radium therapy. If these statements are correct, there must be some reason for the disappointment met with in practice. The most obvious explanation would be that radium has been improperly used; but there is another factor which has to be considered. Though the action of radium on neoplastic tissue is not fully understood, it is believed that when a tumour disappears after radium treatment, not only are the tumour cells destroyed by the radium, but the débris which remains is removed by the activity of the neighbouring tissues. It is probable that tissues vary in their ability to deal with such irradiated tumour substance, and such variation might underlie the puzzling behaviour of apparently identical tumours when growing in different parts of the body—for example, an epithelioma of the lip or of the skin of the face disappears rapidly when it is treated by radium, whereas a tumour morphologically indistinguishable growing at the angle of the mouth is extremely resistant; and, again, the response of a primary growth is often very different from that of secondary deposits growing in the lymphoid tissue of a gland.

The reaction which takes place in the brain around a hæmorrhage, or in and around a contused area, is very different from that which occurs in the connective tissues of the body; and whereas in the latter a comparatively small amount of scar tissue is all that remains shortly after an injury, in the brain the process is very much slower, and an area of gliosis, or softening, or a cyst, may be the final result.

In the past our attention has been directed to the cells of the growth almost to the exclusion of the medium in which they are growing. On several occasions it has seemed advisable to excise the indurated portion of a breast which sometimes remains after a carcinoma has been healed by radium. When this tissue is examined, it is usually found to consist of fibrous tissue with a few foreign-body giant cells, and there may be no trace of the carcinoma. The neoplastic cells are presumably destroyed by the radium, and their remains are scavenged away by phagocytes and removed along lymphatic channels. In the brain this scavenging process is probably much less efficient. One of our patients who had been treated with X rays for a deep glioma died as a result of a street accident four months later. When the brain was examined an enormous mass of dead tumour tissue was found; the necrosis may have been the result of X-ray treatment, but nothing was found to show that the dead tissue was being removed. We cannot tell at present how important this aspect of the problem may be, and we are trying to test the hypothesis by experiment. Carmichael has been able to grow a tumour (Pearce-Brown tumour) in the rabbit's brain, and we have recently been applying radium to these tumours. We have not made sufficient observations to justify any conclusions, but we are trying to compare the growth of this tumour in connective tissue and in brain tissue, and its reaction to radium in these situations.

Writing in 1927, Sir James Purves-Stewart expressed the hope that in time surgical operations may be discarded in favour of other more efficient and gentler methods, biochemical or physical, whereby we shall be able to melt away growths, no matter how deeply seated or how insidiously

infiltrating. The time is not yet; but, though the hope that radium might melt away growths in the brain has not yet been fulfilled, much remains to be done before its true value in the treatment of cerebral tumours is known.

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[8] Horsley and Finzi, *Brit. Med. Jour.*, 1911, ii, 898.
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[10] Sargent and Cade, *Brit. Jour. Surg.*, 1931, xviii, 501.
[11] Hyslop and Lenz, *Amer. Jour. Med. Sci.*, 1928, clxxvi, 42.
[12] Pancoast, *Amer. Jour. Roentgenol.*, 1928, xix, 1.
[13] Cairns, Personal communication.

INTERARTICULAR SYNOVIAL FOLDS.

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This article, with its accompanying illustrations, calls attention to the constancy with which folds of synovial membrane are to be found in healthy and normal joints, to the extraordinary extent to which these folds project between the articular surfaces of bones, and to the fact that they occur at all ages.

That fringes and pedunculated outgrowths of the synovial membrane lining joint cavities may exist in the pathological state is very well known, but anatomical and surgical text-books do not furnish adequate indications of the presence of synovial folds in health. References to them are so lacking in descriptive detail that it may be doubted if their presence can be generally known or their clinical importance appreciated. They are apt either to be destroyed by the incision which opens the joint or else to be unfolded when the joint capsule is put upon the stretch, and so they elude detection. In fact, for their effective display, the tissues of the joint must have been so fixed and hardened that the folds retain both their shape and position when the joint is opened. Once, however, their existence, nature, and position are appreciated, no difficulty will be found in devising suitable means to display them.

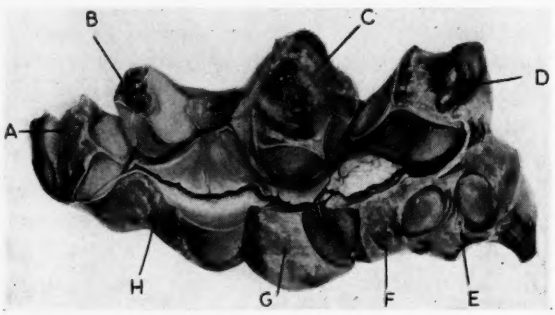

FIG. 488.—Transverse carpal joint, adult, viewed from the palmar aspect. A, Greater multangular ; B, Lesser multangular ; C, Capitate ; D, Hamate ; E, Pisiform ; F, Triangular ; G, Lunate ; H, Navicular.

It will be sufficient in the meantime if the existence of these extensive folds be emphasized, for once their existence is known their profound clinical significance becomes apparent. It will not be necessary to do more here than suggest that when a joint is sprained some of its folds are of necessity crushed and bruised, and that the bruising may result in the formation of adhesions, and further that these folds may suffer from various infections as do the valves of the heart. The mechanical and physiological parts they play need not be commented upon just now.

Our attention was first directed to these constant and extensive folds by a dissecting-room specimen of the transverse carpal joint of which *Fig.* 488 is a reproduction. When in this particular specimen the joint was opened from the front a broad apron-like fold of synovial membrane was seen to

project from the posterior part of the capsule and to occupy a position between the two rows of bones. The free edge of the fold is thin; its base contains a trace of fat, which is an extension from the fat that occupies the occasional intervals between the fibrous and synovial capsules of this and other articulations. Subsequent dissections showed that, had this joint been opened from the dorsal aspect, a corresponding fold would have been seen to project from the volar aspect of the capsule.

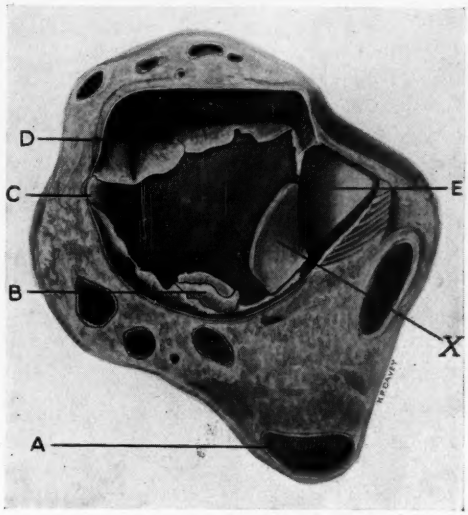

FIG. 489.—Ankle-joint, adult, viewed from below. The talus has been removed from its socket. A, Tendo calcaneus; B, Folds; C, Tibial malleolus; D, Fold; E, Fibular malleolus; *X*, Fatty pad.

Figs. 489 and 490 show dissections of the left ankle-joint. In each the talus was so removed that any folds of synovial membrane which might intervene between it and its socket (formed by the malleoli and the lower articular end of the tibia) should not be disturbed. In both figures the socket is viewed from below. The fatty pad, marked *X*, is represented in several text-books and atlases, but the folds which are clearly seen to underlie the periphery of the articular surface of the tibia have not, to our knowledge, hitherto been either depicted or clearly described. *Fig.* 489 was taken from an adult; *Fig.* 490 from a child at birth—and the dispositions of the folds in the two specimens are very much the same.

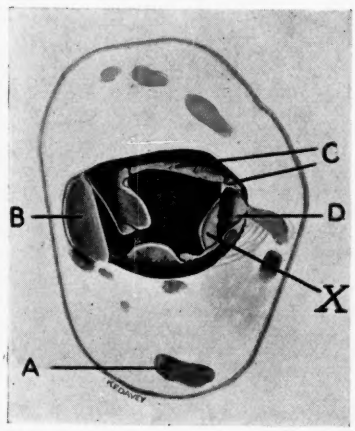

FIG. 490.—Ankle-joint at birth. A, Tendo calcaneus; B, Tibial malleolus (cut across); C, Folds; D, Fibular malleolus; *X*, Fatty pad.

Figs. 491–493 are of the elbow-joint. In *Fig.* 491 the capsule was incised from the front and the collateral ligaments were divided in order to allow the humerus to be gently displaced upwards. This done, the appearance obtained was as depicted—that is to say, folds are seen to encroach on the semilunar notch of the ulna from both sides, and a fold which is almost circular overlies the peripheral portion of the upper aspect of the head of the radius.* This latter fold intervenes between the radius and the humerus much as the semilunar cartilages intervene between the tibia and the femur. In *Fig.* 492 this fold is actually composed of fibrocartilage, and might in this particular instance be referred to as the 'semilunar cartilage' of the

* Several British, French, and German text-books refer to these folds.

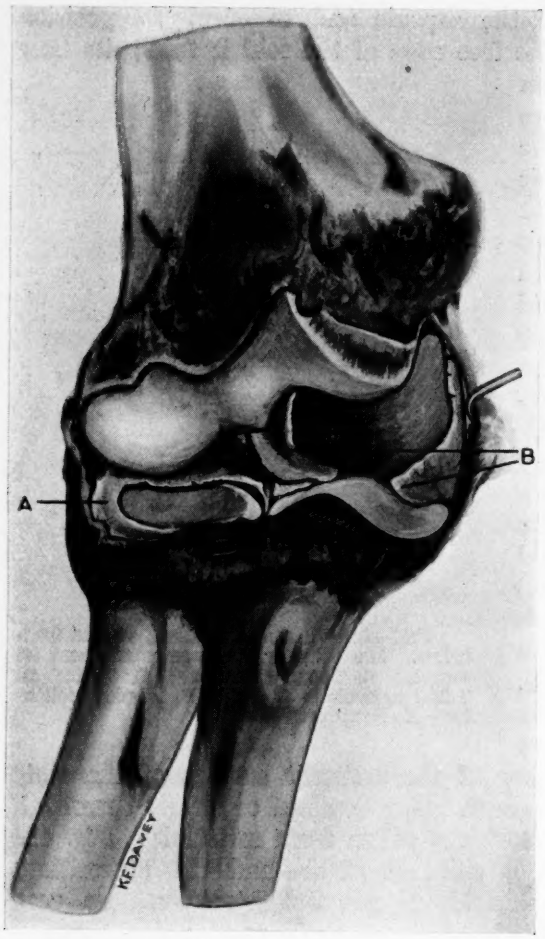

FIG. 491.—Elbow-joint, adult, viewed from in front. A, Circular fold on head of radius; B, Folds.

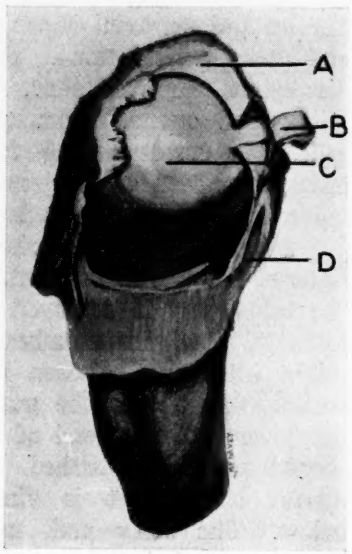

FIG. 492.—Circular fold on head of radius. The fold in this specimen is fibrocartilaginous (adult). A, Fold; B, Portion reflected to show thickness; C, Head of radius; D, Annular ligament.

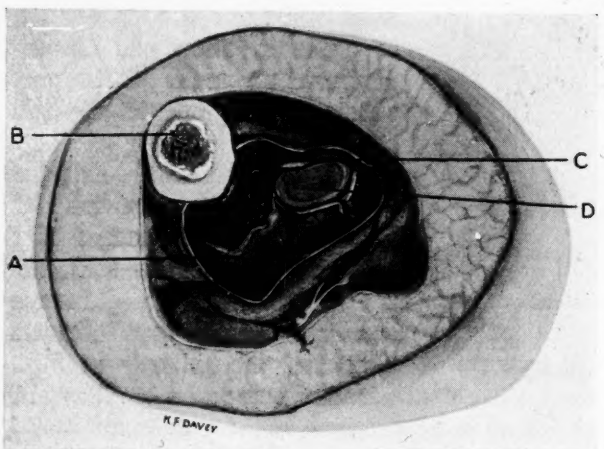

FIG. 493.—Elbow-joint at birth, viewed from above after removal of humerus. A, Fold; B, Olecranon (cut across); C, Fold; D, Head of radius.

radio-humeral joint. The fringes projecting from its anterior end are no doubt pathological.

Fig. 493 is a dissection of the elbow-joint at birth. The capsule was incised all round the joint and the humerus lifted away with as little disturbance to the synovial membrane as possible. The head of the radius and the semilunar notch of the ulna are in this specimen viewed from above. It will be noted that the folds which are present in the adult specimen are present also in the healthy joint of the child at birth, and are, therefore, not the products of age changes occurring as life progresses, neither are they pathological products.

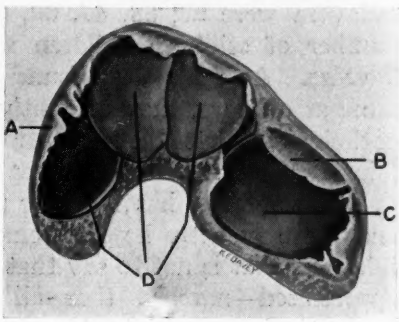

FIG. 494.—Intertarsal joints, adult. The cuneiform and cuboid bones are viewed from behind. A, B, Folds; C, Cuboid; D, Cuneiform bones.

In *Fig.* 494 the posterior portion of the foot bearing the talus, the navicular bone, and the calcaneus have been removed, leaving the posterior aspects of the cuboid and of the three cuneiform bones exposed. This specimen shows well the characteristic manner in which folds project into healthy arthrodial joints. Under dissecting-room conditions such folds are quite transparent save at their attached margins or bases.

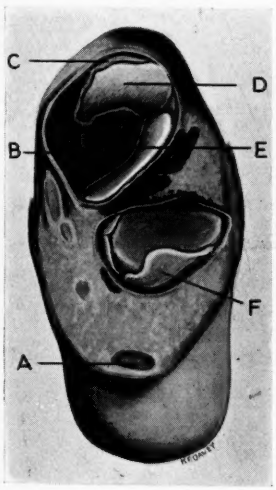

FIG. 495.—Talo-calcanean and talo-calcaneo-navicular joints at age of 3 years, viewed from above. The talus has been lifted off. A, Tendo calcaneus; B, Spring ligament; C, Fold; D, Navicular; E, Fold on anterior and middle facets of calcaneus; F, Fold on posterior facet of calcaneus.

Fig. 495 is taken from a child of 3 years. The talus has been freed and carefully lifted away from the calcaneus and the navicular bone, and, as a result, the extent to which folds project into the talo-calcanean and talo-calcaneo-navicular joints is well seen. The talus must in part have rested upon these folds. All these folds are present at the time of birth and persist into adult life. The fold, for example, which is seen to overlap the anterior and middle calcanean facets was present in each of the nine adult specimens we examined.

In brief: in the anatomy rooms our attention was directed to a large fold of synovial membrane which projected far between the two rows of carpal bones and bore their impress. This fold was healthy and not pathological. Investigation revealed its presence in other limbs. Inquiry was then extended in a systematic manner to all the limb joints of the nine cadavera which were then being dissected, the hip-joint alone being unavailable for study. In some dissection had been too thorough for our purpose; in others the specimens were too dry to be of use. Nevertheless, the material was sufficient to make it perfectly clear that it is the rule for diarthrodial joints (including even such small joints as the intercarpal, intertarsal,

interphalangeal, and superior tibio-fibular) to contain interarticular folds. The illustrations are selected from the various dissections. The ages of the cadavera were 27, 38, 47, 60, 60, 62, 70, 73 and 77 years. The joints of a number of stillborn children were examined, and the joints of a child of 3 years. As folds were found at all ages, and as they are practically the same at all ages, they evidently are not acquired structures, neither are they pathological, but they appear to be necessary parts of the mechanism of joints. That they are of great clinical importance is only too apparent.

The surgeon has for long removed the semilunar cartilage of the knee, and more recently he has removed the posterior part of the humero-radial fold, but that is not to say that the generalization here exemplified is properly appreciated—namely, that all movable joints have at all ages extensive interarticular synovial folds.

My thanks are due to Professor Donald Mainland for checking observations and for collaborating generally in this work.*

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* The specimens and the original drawings from which these photographs were made are in the Museum of the Department of Anatomy, the University of Manitoba.

INTRAVENOUS LOCAL ANÆSTHESIA.

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Historical Note.—In 1910 I had the privilege of listening to a lecture delivered by Auguste Bier, then professor of surgery at Bonn, in which he expounded the method of intravenous anæsthesia which he had introduced.[1] His technique involved the isolation of an ischæmic section of a limb by means of elastic bandages, the exposure of a vein under infiltration anæsthesia, and the washing out as completely as possible of the whole venous system of that section. Under pressure, 50 to 100 c.c. of ½ per cent novocain solution was then forcibly injected. Anæsthesia of the segment isolated was stated to be immediate and to be 'very satisfactory'. At the end of the operation the venous system was again washed out with saline, the elastic bandages were released, and the wound was closed. Although safe and certain, it can be seen that this technique is tedious and complicated.

In 1909 Goyanes[2] and in 1913 Braun[3] published descriptions of what they called 'intra-arterial' local anæsthesia. After cutting down on 'an artery' under novocain infiltration, 50 to 100 c.c. of ½ per cent novocain solution was injected into the artery, circulation having been arrested by tourniquet immediately before the injection. Anæsthesia came on in 'one to two minutes'. This is somewhat simpler than Bier's method, but still involves an operative interference, which may be far from simple, for the induction of the anæsthesia.

For the last five or six years I have used a method which calls for the use of one tourniquet and one needle puncture only. The underlying principles are somewhat different from those of Braun's and Bier's methods.

Technique.—No time is spent on isolating a segment of a limb. The whole limb distal to the tourniquet is dealt with. There is no advantage in trying to limit the area of anæsthesia, and as a matter of fact it is not possible to do so even by Bier's technique. By means of an elastic bandage or thoroughly padded tourniquet of calibre suited to the bulk of the limb, the arterial circulation is arrested at a convenient level in arm or thigh. Pressure should be applied slowly so as to ensure distension of the veins.* With a fine needle on a Record syringe a superficial vein is entered and a quantity of novocain solution injected. The injection is usually made in the distal direction. A pad and bandage is applied to prevent possible leakage into the tissues. The amount used has varied from 6 c.c. of 2 per cent

* The distended veins are easily seen and clipped before division, and hæmorrhage is no more troublesome than in any other operation.

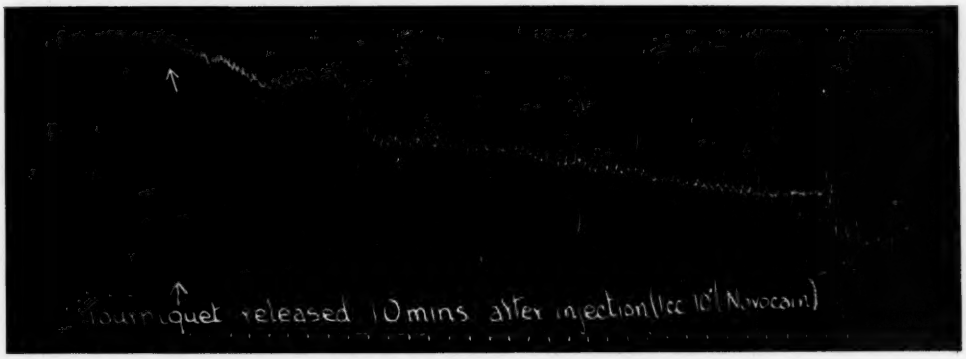
to 12 c.c. of 3 per cent solution, according to the size of the limb to be anæsthetized. The method has so far only been employed in adults. The 6 c.c. of 2 per cent was definitely too small a dose, but 10 or 12 c.c. of 2 per cent is perfectly successful in dealing with an upper limb. The case in which the maximum dose was given—12 c.c. of 3 per cent—was a well-developed though elderly man with a compound fracture-dislocation of the ankle. The injection was made into the dorsal venous arch on the foot and the tourniquet applied above the knee.

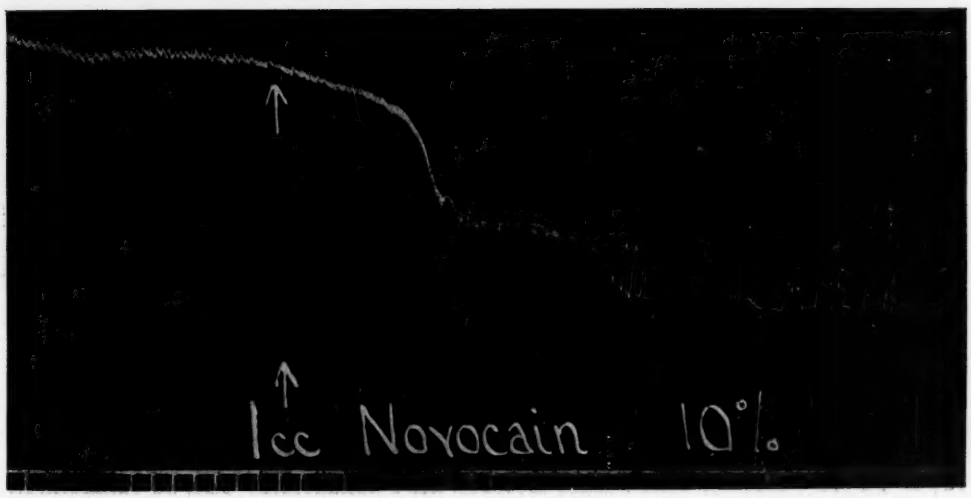
In about eight minutes I find that sensation is sufficiently abolished in the deeper parts of the limb to permit of operative interference. Anæsthesia of the skin, however, may not be complete. If this is so, I rapidly infiltrate subcutaneously the line of the incision with ½ per cent novocain and proceed at once. Bier found that, in his method at least, cutaneous anæsthesia of the distal part of the limb was sometimes delayed for as long as twenty minutes. When fully established anæsthesia is absolutely perfect so that even wrenching and dislocating movements give no pain. When the operation is over—but never in less than half an hour after the injection of the anæsthetic—the tourniquet is slowly released so that blood from the limb reaches the general circulation only gradually. This was done in the first instance in fear of toxic symptoms. Bier has shown that novocain cannot be washed out of the limb once anæsthesia has been established, so that apparently care in this direction is not absolutely essential. Nevertheless it is a step in technique which I shall continue to carry out.

Type of Anæsthesia.—The area of cutaneous anæsthesia ultimately extends in many cases as high as the lower edge of the tourniquet, and must therefore be the result of direct action on terminal nerve filaments. In part, however, it is possible that the effects produced are more truly to be described as a regional anæsthesia caused by the drug reaching nerve-trunks comparatively near the site of injection. That this is likely is shown by Bier's cases, in which anæsthesia of the distal portion of the limb occurred, even although his own work proved that no novocain could reach the parts beyond the elastic bandages. The upper limit of deep anæsthesia is not easy to determine. It would seem from Bier's cases that it does not fall far short of the level of the upper tourniquet. In my cases, as it has happened, no suitable occasion for testing this point has arisen.

To what distance novocain actually travels in the dilated (but stagnant) venous channels is perhaps impossible to determine. The relatively high concentration of the solution injected would make it likely that diffusion will play a considerable part. It has been shown experimentally by Petrow[4] that this does actually occur. After ligaturing a rabbit's ear a small quantity of ½ per cent indigo-carmine was injected into the lateral vein. The ear was watched by transmitted light, and "it was easy to see how, despite the arrested blood-stream, the blue-coloured vessels became gradually lighter, while the surrounding tissues became blue. The diffusion process has in one to two minutes quite definitely commenced, and it reaches its maximum in fifteen to twenty minutes." It will be seen that this corresponds closely to the time during which the 'detoxication' of novocain occurs in the following experiments.

During the operation it is noteworthy that the pain from the tourniquet is greatly diminished in comparison with what results when constriction is applied to an unanæsthetized limb. No doubt still greater comfort could be assured by the use of pneumatic pressure, but of the various types of such tourniquets which I have tested none has been sufficiently constant in pressure to satisfy me that there was no risk of leakage of novocainized blood into the circulation during the course of the operation.





FIGS. 496, 497.—Blood-pressure tracings. The wide excursions towards the right-hand ends are caused by artificial respiration.

Experimental Investigations.—By the courtesy of Professor Dilling, of the Department of Pharmacology in the University of Liverpool—to whom I am indebted for much help—Dr. G. Griffith has carried out a series of experiments for me to determine to what degree and at what rate the 'fixation' of novocain in the tissues takes place. With a tourniquet so applied as to arrest the circulation in the hind limb of a 5-lb. cat, 1 c.c. of 10 per cent novocain (1·5 gr.) was injected into a distended vein. After ten minutes the tourniquet was released so that the blood from the limb entered the general

circulation. No change follows the actual injection of what is proved to be an exceedingly poisonous dose. After ten minutes there is, however, apparently sufficient novocain left to give rise to quite a serious fall in blood-pressure (*Fig.* 496), as well as a respiratory embarrassment which for a moment gave anxiety. Five minutes later the same dose was injected into the same vein, this time without the tourniquet (*Fig.* 497). There was immediate cessation of respiration and a fall of blood-pressure practically to nil. The animal, it is true, recovered, but only after prolonged artificial respiration by means of direct insufflation of air through a tracheal cannula. To exclude the possibility of cumulative action of the drug, a series of sublethal doses were given to another animal without ill effect.

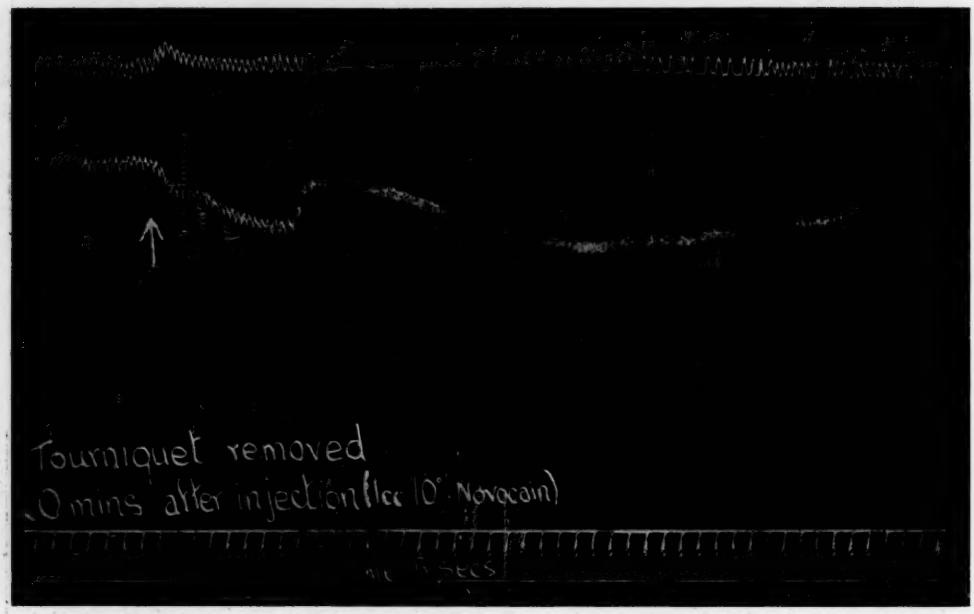


FIG. 498.—The upper tracing is a respiratory record. The fall of blood-pressure immediately following release of the tourniquet is probably due to mechanical causes. It is followed by the more prolonged effect of still 'unfixed' novocain.

The experiment was then repeated as follows. In a slightly larger cat (5½ lb.) both posterior limbs were isolated by a tourniquet, and an intravenous injection of 1 c.c. of 10 per cent novocain was made into each. After twenty minutes one tourniquet was released, with the very mild vascular and respiratory effects shown in *Fig.* 498. After thirty-five minutes the circulation in the other limb was restored. There was no disturbance of respiration and only the slightest fall of blood-pressure (*Fig.* 499). As it seemed very possible that this minimal response might be due, not to traces of unaltered novocain, but to mechanical changes resulting from the release of the tourniquet, this procedure was carried out without any injection of the drug. The tourniquet was applied as a figure-of-eight round the lower abdomen and upper thigh, and it will be seen (*Fig.* 500) that there is a slight rise of blood-pressure following its application, and a fall when it is released, perfectly comparable to the

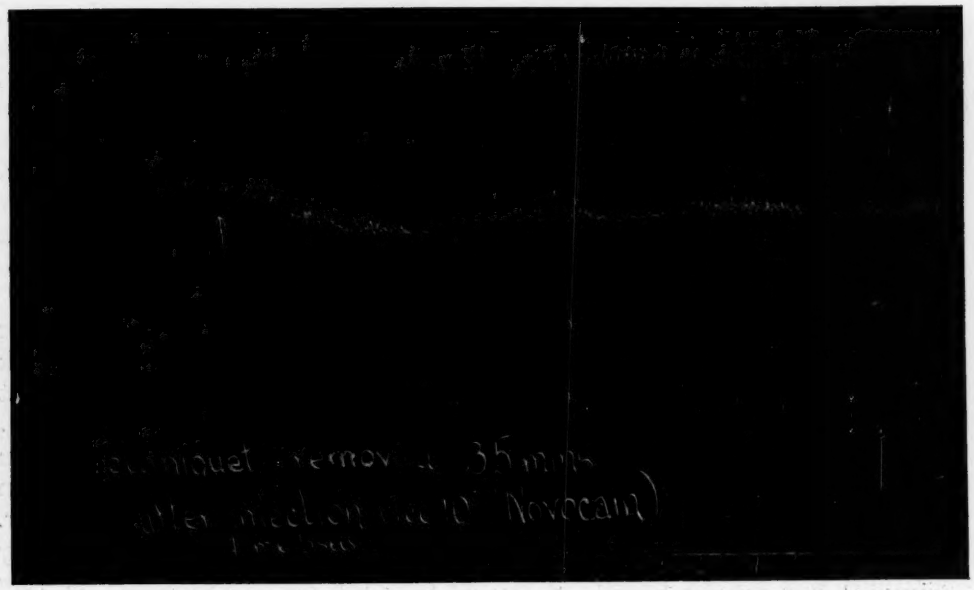


FIG. 499.—Note similarity of changes to those seen in second half of *Fig.* 500.

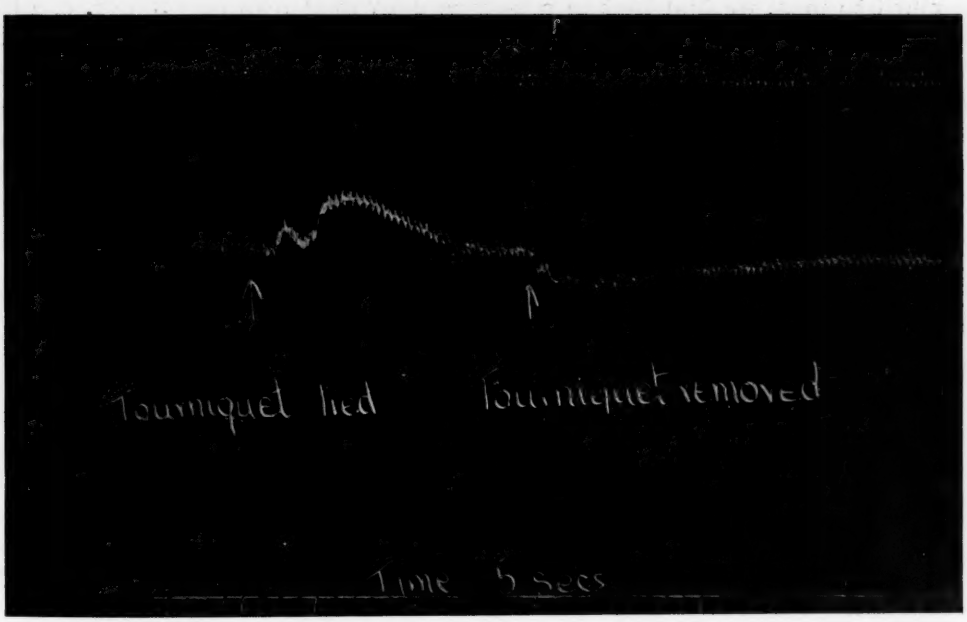


FIG. 500.—No novocain injected; changes in blood-pressure solely due to mechanical effects of tourniquet.

tracing in *Fig.* 493. It would appear, then, that after the lapse of thirty-five minutes the dose of novocain had in some way become completely innocuous.

A good deal of work has been done in this connection with cocaine, and it is not unreasonable to suppose that the findings may also be applied to novocain. Rifatwachdini[5] states that cocaine injected (? intramuscularly) into a ligatured limb and left for several hours is not destroyed, and gives evidence in favour of a process of adsorption having taken place, since the toxicity of the drug is progressively diminished. This latter fact is also noted by Kohlhardt,[6] who used the intravenous route. Maurel and Pouchet observed that toxicity was diminished by incubating novocain with nervous tissues, but does not say whether this is in any sense a reaction specific to such tissues. There is apparently a very slow release of such 'adsorbed' novocain, but this is not of sufficient importance to make cumulative or delayed action in any way dangerous (Rifatwachdini[5]). This author's work definitely negatives the conclusions of Wiechowski,[7] who maintains that cocaine is largely destroyed in the body.

Application of Experimental Results to Man.—The dose employed in these experiments has been 1 c.c. of a 10 per cent solution of novocain. On the basis of the second experiment this is equivalent to a dose of 35·28 gr. for an adult weighing 9 stone. The maximum dose injected in any of my operations was almost exactly 5 gr., so that the margin of safety is very considerable.

Incidentally it has been shown by Dr. Griffith—to whom my best thanks are due—that a dose of $\frac{1}{33}$ gr. per pound weight can be injected into the jugular vein of a cat without untoward effects. Assuming that these results can be applied to man, we find that in a 9-stone individual 3·78 (say $3\frac{3}{4}$) gr. can be safely injected directly into the blood-stream. It is not suggested that such a fact is any justification for carelessness—the more so as individual idiosyncrasies to novocain are well known. Nevertheless, it must come as a welcome relief to the surgeon who fears the possibility of unwittingly making an intravascular injection in the course of an infiltration anæsthesia. It is also to be noted from these experiments that in overdosage, although both fall in blood-pressure and respiratory failure occur, it is the latter which is the more serious and demands the more immediate attention.

Indications.—The following types of case have been dealt with by this method of anæsthesia: (1) Compound fractures and dislocations of the carpal and tarsal bones and joints; (2) Tuberculous disease of the same structures; (3) Tuberculous tenosynovitis; (4) Ganglion of the wrist. In no case have bad results of any kind been seen.* There is no reason why amputations, or indeed any other kind of operative work, should not be done in parts of the body capable of being isolated in this way from the general circulation. In amputations, however, where possible, it would be wise, in order to minimize the loss of blood, to make the limb distal to the operation area ischæmic by means of an Esmarch's bandage before applying the ordinary tourniquet.

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*Since writing this paper one case has occurred in which removal of the tourniquet was followed by a momentary syncope and then vomiting. No treatment was necessary, and it is quite possible that the condition was purely psychological in origin.

In the cases in which I have employed intravenous local anæsthesia it has usually been the fear of chest complications in tuberculous subjects that has led to its use. It has also been useful in elderly patients suffering from shock, although in the presence of advanced arterial disease the use of the tourniquet might perhaps be viewed with concern. There can be no doubt that if one were working single-handed it would be invaluable in dealing with lacerations, fractures, or dislocations of the extremities, on account of its simplicity, certainty, and safety. It is not suggested that in the lower limb it should replace spinal anæsthesia, but even there occasions do arise when the necessary solution and a suitable needle are not available for the latter technique.

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[4] Petrow, *Zentralb. f. Chir.*, 1909, 482.
[5] Rifatwachdini, *Biochem. Zeits.*, 1913, liv, 83.
[6] Kohlhardt, *Arch. f. klin. Chir.*, 1902, lxiv, 927.
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NON-PARASITIC CYSTS OF THE LIVER: THEIR CLINICAL AND PATHOLOGICAL ASPECTS.*

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THE following case-history is that of a patient who entered the Montreal General Hospital with the signs and symptoms of acute cholecystitis. She was admitted into the service of Professor A. T. Bazin, who at operation found her illness to have resulted from a hæmorrhage into a non-parasitic cyst of the liver.

CASE REPORT.

HISTORY.—Mrs. M., 61 years of age, for thirty-five years had had recurring attacks of distress following the eating of certain foods. These attacks, which were often months apart, came on at various periods after meals, lasted from one to six hours, cleared up spontaneously, and were characterized by a sense of weight in the epigastrium, eructations of gas, nausea, and sometimes vomiting. They were never accompanied by fever, chills, pain, melæna, or clay-coloured stools. Several weeks before admission to the hospital the patient noticed a 'lump' in the right upper quadrant. This did not increase in size and gave no symptoms until two weeks previous to admission, when she was suddenly seized with a knife-like pain across the upper abdomen. The pain was so acute and so severe that it was not relieved by hot applications or a hypodermic of morphine. This pain, which at times radiated to the back and both shoulders, lasted for two hours, and was accompanied by profuse perspiration, nausea, and repeated vomiting. For several days following there was soreness in the right upper quadrant, anorexia, slight nausea, and general malaise. There were no chills, fever, or subsequent jaundice.

ON EXAMINATION.—On admission to hospital physical examination showed a well-developed, somewhat obese female. There was swelling and tenderness in the right upper quadrant of the abdomen, and Murphy's sign was positive. The liver edge was felt two finger-breadths below the right costal margin, but no mass could be palpated. Red blood-cells 4,800,000, white blood-cells 5400, and hæmoglobin 55 per cent. The van den Bergh reaction was negative. X-ray examination of the gall-bladder was negative. A clinical diagnosis of acute cholecystitis was made.

OPERATION.—Professor Bazin, who operated upon the patient under gas-oxygen anæsthesia, found a dark-bluish globular cyst projecting from the anterior margin of the right lobe of the liver (*Fig.* 501). The free surfaces of the cyst were covered with thickened peritoneum, which in places was arranged in strands. On palpation this cyst was found to extend some distance into the liver substance, and involved

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* From the Surgical Service of Dr. A. T. Bazin, Professor of Surgery in McGill University, and the Department of Pathology, Montreal General Hospital, Montreal, Canada.

the posterior inferior surface of the right lobe, where it extended beyond the transverse fissure. The falciform and suspensory ligaments separated the cyst from the left lobe.

On the superior surface of the right lobe of the liver, and 2½ cm. from the lateral margin of the larger cyst, there was a smaller cyst of a similar appearance. This was punctured with a trocar, and 5 c.c. of clear amber fluid were withdrawn,

FIG. 501.—Drawing of the liver cyst as it appeared at operation. A schematic sagittal sectional view is added to demonstrate the depth and size of the cyst.

when this cyst collapsed. On opening this small cyst it was found to be 3 cm. in diameter, and was lined with a glistening membrane which could not be readily stripped off. A trocar was then inserted into the larger cyst and 500 c.c. of chocolate-coloured, cloudy fluid were removed. This cyst extended 16 cm. into the liver substance, and, like the smaller cyst, was lined with a glistening membrane which was intimately attached to the liver tissue. Under observation the cyst cavity decreased in size.

A portion of each cyst wall was removed for pathological examination, after which the larger of the two cysts was packed with iodoform gauze and marsupialized to the parietal peritoneum. The contents of the larger cyst were sterile, and there were no scolices or hooklets.

Recovery was rapid and uneventful. The larger cyst was entirely obliterated and the small one healed in five days. There has been no recurrence, and the patient is well.

PATHOLOGICAL REPORT (S–25–924 Department of Pathology, the Montreal General Hospital).—Numerous sections from the walls of the cysts were stained. "The structure of both cysts is essentially the same. The wall is made up almost entirely of connective tissue, lined on its inner surface by a single layer of flattened non-ciliated epithelium, and covered on its free surface by peritoneum. The fibrous-tissue wall of these cysts is divided into three fairly distinct zones: (1) An inner narrow zone of densely packed connective tissue with relatively few nuclei, but well vascularized. (2) A central zone which contains a much less dense connective tissue than the inner zone, nuclei are plentiful, and there are numerous blood-vessels and lymphocytes. Some of the blood-vessels are dilated. In this middle zone a number of well-formed bile-ducts are seen, some of which are also slightly dilated. (3) An outer zone which is composed of rather loosely arranged, fairly cellular connective tissue with a few elastic fibres. The surface is covered with peritoneum.

"Throughout the wall of the larger cyst there is some œdema and a fairly diffuse infiltration of polymorphonuclear leucocytes, with fewer lymphocytes and plasma-cells. In places the epithelial lining of the large cyst is absent. The location of the vessel or vessels that led to the hæmorrhage into the cyst is not found."

"*Pathological Diagnosis.*—Non-parasitic cysts of the liver of the bile-duct type, with hæmorrhage into the larger one and a consequent acute inflammation."

COMMENTARY.

The correlation between the signs and symptoms and the operative finding in the above case seems clear. The sudden onset of very acute symptoms and the condition which necessitated an operation were the result of a sudden hæmorrhage into the larger of the two congenital cysts of the liver.

Besides the non-parasitic cysts of the liver just described, 10 others have been obtained from 6141 post-mortems performed in the Department of Pathology of the Montreal General Hospital during the past twenty-four years. A description of a representative one is as follows: It was from a patient who had never shown any signs or given symptoms referable to the liver, gall-bladder, or gastro-intestinal tract. There were several so-called 'daughter cysts'. The histological findings of the cysts were in general similar to that described above, except that the inner wall showed definite trabeculation, both in the gross and microscopically. The three zones of connective tissue into which the wall of our cyst obtained at operation was divided—an arrangement noted by other observers—were not well marked in our post-mortem case. Nevertheless, we feel that it also is a bile-duct retention type of liver cyst.

There are numerous references in the literature to non-parasitic cysts of the liver. We are, however, especially interested in those that have come to operation, either because of symptoms resulting from the cysts themselves, or because of complications depending upon them.

Muto and Hanzawa[1] recently reviewed the cases of non-parasitic cysts

of the liver that had been operated upon. They found reports of 75 cases, 65 of which had been reported since 1900. They added one case of their own that was successfully operated upon, making a total of 76 cases reported to that date. Our case brings the number to 77.

In most instances non-parasitic cysts of the liver are symptomless, and when they are not, the clinical signs and symptoms are rarely characteristic enough to permit of a positive diagnosis except at operation. For these reasons it is safe to assume that the condition is more common than it is generally thought to be by most surgeons. This is substantiated by the finding of single or multiple non-parasitic cysts of the liver at post-mortem which have never led to symptoms during life.

So many different types of non-parasitic cysts may occur that it would be inexpedient to include the detailed pathological anatomy of all of them, but our surgical case and our post-mortem case are so fairly representative of what has been known as bile-duct retention cysts that they may be taken as typical examples. The presence of 'daughter cysts' opening into or lying adjacent to a principal cyst, as in both our cases, had frequently been referred to, notably by Muto and Hanzawa. These 'daughter cysts' may vary in size from a few millimetres up to 2½ cm. in diameter, or, as in our own case, may be even larger. The main cyst may, on the other hand, reach the proportions of a man's head, or even fill the abdominal cavity. Large cysts are often solitary and are usually unilocular. They may, however, be trabeculated, as in our post-mortem specimen, giving the cyst somewhat of a multilocular appearance. Large non-parasitic cysts occur more frequently in the right lobe of the liver than in the left. According to Sonntag,[2] the proportion is 8 : 6. Very rarely do they occur in the quadrate lobe. Cystadenomata, which have the power of unlimited growth, have been found replacing almost the entire liver substance. The content of the cyst depends upon the type of the cyst, its duration, and whether complications have developed. Retention cysts usually contain débris and bile-pigment in their earlier stages. In older cysts of this type these may be absent, the bile having been absorbed. When this stage is reached the contents are usually turbid, viscid, greenish-yellow, or chocolate-coloured, the result of hæmorrhage. In some instances the contents may be slightly gelatinous. If infected, the material will become purulent. The specific gravity of the contents of the cyst varies from 1007 to 1024. The contents are neutral or slightly alkaline, and chemical examination of them shows the presence of albumin. Less consistently, one finds bile-pigment, glycogen, mucus, and even blood; sugar and succinic acid have never been found. Microscopically there may be fat-droplets, fatty-acid crystals, cholesterin crystals, hæmatoidin crystals, leucocytes, red blood-cells, and even fibrin.

Classification.—Several classifications of non-parasitic cysts of the liver have been made. Sonntag offers the following:—

- Blood and degeneration cysts (the latter resulting from the breaking-down of tumours, gummata, etc.)
- Dermoid cysts
- Lymphatic cysts
- Endothelial cysts
- Retention cysts (arising from bile-duct retention)
- Proliferation cysts (cystadenomata and adenomata).

He attaches a special significance and gives a special place to endothelial cysts. He believes that they include not only most of the multiple minute cysts, but many of the larger ones.

Thöle[3] merely subdivides the cysts into two large groups :—

Lymph and blood cysts	Cystadenomata.

He would include the bile-duct retention type exemplified in our case among the cystadenomata.

J. F. X. Jones[4] has given a much more detailed classification, based upon the origin of the cysts :—

Those of teratomatous and embryonic origin	Bile-duct retention cysts
Pseudocysts (degeneration cysts)	Cystadenomata
Lymphatic cysts (single or multiple)	Ciliated epithelial cysts
Cysts of blood-vessel origin	Cystic degeneration of the liver and kidneys.

This classification is the most complete, possibly the most accurate, and includes practically all the cysts that theoretically could originate in the liver.

Etiology.—We have been unable to find in the literature any definite statements as to the percentage of non-parasitic cysts of the liver that are definitely of congenital origin, though they make up the greater number. This is largely due to the wide divergence of opinion among such writers as Virchow, Leppmann,[5] Sonntag, Thöle, Jones, and others, as to the origin of these cysts of the liver. The teratomatous dermoids and ciliated epithelial cysts are so rare that they may be dismissed with a word, but they are certainly of congenital origin. Lymphatic cysts, whether single or multiple, large or small, and the blood-vessel cysts, also fall within this grouping. Of the bile-duct retention cysts many are undoubtedly congenital. We believe the cysts in our operative and in our post-mortem cases are of the congenital type. Thöle says that cirrhotic changes in the liver, particularly of the biliary type, undoubtedly account for a number of these cysts. Most of the cystadenomata are considered by the majority of authors to be secondary to cirrhosis. Cystic degeneration of the liver and kidneys is also of congenital origin. This leaves only the so-called 'degeneration cysts' to be considered, and these obviously fall into the acquired group. It seems clear, therefore, that the great majority of non-parasitic cysts of the liver are of congenital origin. The following table shows the congenital and acquired types :—

Congenital	Acquired
Teratoma	Degeneration cysts
Lymphatic cysts	Cystadenomata
Blood-vessel cysts	Bile-duct cysts associated with acquired cirrhosis of the liver.
Ciliated epithelial cysts	
Cystic degeneration of the liver and kidneys	
Bile-duct retention cysts.	

Diagnosis.—The very nature of the non-parasitic cysts of the liver makes their pre-operative diagnosis very difficult—so difficult, in fact, that

some authors, as Leppmann, state that an exact diagnosis can be made only at operation.

These congenital cysts are small at first, and usually increase in size so slowly that the liver and even the adjacent organs adapt themselves to their presence without as a rule producing any signs or symptoms unless complications develop. These are, most commonly, sudden undue pressure on the common bile-duct or one of the adjacent organs; secondary infection; or, as in our case, acute hæmorrhage into the cyst cavity. In our case cyst of the liver was not considered in the differential diagnosis. Occasionally an enlarging cyst may pull upon the peritoneum and cause pain of an indefinite character. Less frequently, a cyst arising from the upper surface of the liver may, upon enlargement, cause compression of the lung and even cardiac displacement, with a resulting intermittent dyspnœa, cardiac distress, or both.

Since the favoured location of these cysts is the antero-inferior margin of the liver, pressure from their enlargement most frequently involves the gastro-intestinal tract. As a result biliousness, gastric distension, eructations of gas, anorexia, nausea, and even vomiting may occur. Constipation, or alternating constipation and diarrhœa, may result from pressure on the transverse colon. Very rarely one of the ureters may be obstructed.

Two cases have been described in which pressure upon the portal vein and inferior vena cava has led to ascites and œdema of the legs. Icterus, due to the obstruction of the common bile-duct, has been present in one or two instances. When it has occurred, biliary infection, and not an infected cyst, has been suspected. Not infrequently, as in our case, the patient may present the clinical picture of acute cholecystitis or cholelithiasis. Sometimes these cysts have given rise to a diagnosis of ovarian cyst, as in Stevens's[6] case.

The larger cysts are often pedunculated and may show a marked degree of mobility. Downward displacement, however, is limited by the liver attachment. This point has been emphasized as of help in making a differential diagnosis. In general, it may be stated that the effect of non-parasitic cysts on the general condition of the patient depends upon the extent of the functional derangement produced in the liver and the organs about it as a result of pressure.

Pneumoperitoneum followed by an X-ray has been used as a diagnostic method, but this procedure has been disappointing in its results. The trocar, formerly used to establish the nature of the cyst contents, should be condemned as a method of diagnosis, on account of the danger of contaminating the peritoneal cavity with infected material, or the possibility of implanting scolices of the echinococcus. Hoffmann[7] calls attention to the effect of posture as an aid to diagnosis. He has observed that when pain resulted from peritoneal pull, it disappeared on the patient lying down, while, on the other hand, dyspnœa was often induced or exaggerated. In some of the cases, as in ours, where the diagnosis was established at operation and confirmed by microscopical examination, a tumour was never palpated.

Apart from the question of whether a liver cyst is parasitic or not, numerous other cystic and solid tumours must be ruled out before a definite pre-operative diagnosis can be made. The most important of these are cystic and solid tumours of adjacent organs, particularly the pancreas, kidneys, and

ovaries, rarely the spleen; solid tumours of the liver itself; mesenteric and retroperitoneal cysts, or solid tumours at these sites; hydrops or empyema of the gall-bladder; and tuberculous ascites (Alexander). Hoffmann sums up the possibility of arriving at a definite clinical diagnosis of cysts of the liver with the following postulates:—

Subjective Symptoms	Objective Findings
Increase of pain on standing, and conversely a decrease on lying down	Restricted displacement of the tumour from above downwards even when great lateral mobility exists
Increase of dyspnœa on lying down.	The position of the tumour in relation to the transverse colon.

It will be readily understood, from the wide variation in size and location of non-parasitic cysts, that few of them will fulfil these postulates. Moreover, a differential diagnosis previous to operation is made difficult on account of the similarity in the gross of the various liver cysts. Even if routine tapping of them was justifiable, this would not help much because we know so little about the finer chemistry of their contents. For these reasons one must, in most cases, be content with a diagnosis of "cystic tumour of the liver".

Treatment.—Any non-parasitic cyst of the liver may require treatment at any time, and this is always surgical. Complications such as hæmorrhage, as in our case, or acute infections, demand immediate operation. Wherever it is possible the cyst should be entirely extirpated. Some authors maintain that even the resection of a portion of the liver may be justified. When a cyst is as large as the one here reported and has the anatomical relations of our case, complete resection would scarcely be advisable. When extirpation is impossible, owing to the nature and the location of the cyst, or inadvisable for other reasons, such as infection, the cyst should be laid open, as much of the wall resected as may be expedient, and the cyst then packed and marsupialized, as was done in our case. If anatomical difficulties prevent this, the cyst may be anastomosed with the duodenum as recommended by Everidge. Operative mortality is quoted by Schaack[8] as 12 per cent.

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SHORT NOTES OF RARE OR OBSCURE CASES

A CASE OF INTRACRANIAL AEROCELE OR TRAUMATIC PNEUMOCRANIUM.

By ARNOLD ALCOCK,
SURGEON TO THE GLOUCESTERSHIRE ROYAL INFIRMARY.

W. G., MALE, age 34, porter, was admitted to the Gloucestershire Royal Infirmary under my care on Oct. 25, 1930.

HISTORY.—Six weeks before, about Sept. 13, he fractured his skull as the result of a cycle accident. He was unconscious when picked up, and was promptly taken to the Ross Cottage Hospital. There he was detained for two weeks, and then sent home to Gloucester, apparently cured. Four weeks later, on Oct. 25, his own doctor was called in to attend on account of intense headaches. The doctor advised the removal of the patient to the Gloucestershire Royal Infirmary, and the advice was at once followed.

ON EXAMINATION.—The patient was found to be drowsy, and when roused complained of intense occipital headaches. Attention is drawn to the fact that these headaches were intensified on sneezing. The man vomited shortly after admission. He had incontinence of urine. He had complained of photophobia for the past month. There was impairment of the sense of smell, and slight weakness of the muscles of the left side of the face. Otherwise the cranial nerves and general reflexes were normal. There was a scar on the right side of the forehead, and a fracture of the right frontal bone could be felt beneath. Mr. Niccol, the Ophthalmic Surgeon, examined the eyes, and reported as follows: "Right eye—extensive effusion into the vitreous; no view of the fundus. Left eye—optic disc a little pale, but otherwise eye-ground normal. No suggestion of papillœdema."

Oct. 26.—He was rather more drowsy, but otherwise unchanged: temperature normal, pulse 72, and blood-pressure 110–170.

Oct. 27.—A radiological examination of the skull was made by Dr. Goss, Hon. Radiologist to the Institution. His report was as follows: "(1) There is an intracranial collection of air behind, and under, the right frontal bone. (2) There are two points of fracture of the frontal bone near the middle line, the lower involving both plates of the skull and the right frontal sinus. The upper appears to involve the whole thickness of the skull. The intracranial collection of air is probably entering through the right frontal sinus" (*Figs.* 502, 503).

As no improvement was apparent in the patient's condition, I performed an exploratory operation on the skull, with the assistance of Mr. Bernstein, surgeon in charge of the Nose and Throat Department.

OPERATION.—A large semicircular flap was turned down over the region of the fracture; a small trephine hole was made, and the fractured area of the frontal bone removed. The dura was exposed, but no collection of air (as was to be expected from the X-ray findings) was found. The bone was nibbled away, upon which the dura bulged in the opening to such an extent as to point to greatly increased intracranial tension. A small incision was then made in the dura. No collection of air was tapped, but brain bulged through the dural opening. The opening in the skull was now extended downwards. A curved grooved director was passed in front of, and under, the frontal lobe above the orbital plate of the right frontal bone. At once there was a gush of air, and the bulging brain collapsed. Finally, a large fragment of the frontal bone which had been removed was replaced, and the scalp sewn up.

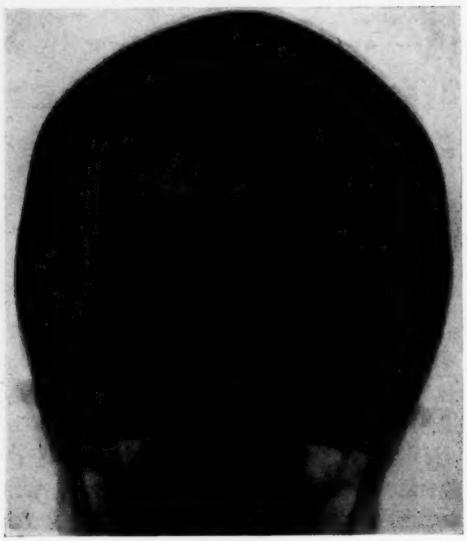

FIG. 502.—Intracranial aerocele: frontal view.

SUBSEQUENT HISTORY.—For three or four days the patient remained in a drowsy state, and continued incontinent. He was, however, free from headaches. About ten days after the operation he regained complete bladder control, and his mental condition approximated to the normal. His blood-pressure at this time was 118–160. He made rapid and uninterrupted improvement, and was discharged on Dec. 3, 'quite well'. On Jan. 8 he was shown at a monthly meeting of the Gloucestershire branch of the British Medical Association, and expressed himself as feeling as well as he had ever done in his life.

FIG. 503.—Intracranial aerocele: lateral view.

Comments.—The interesting points to note in this case are the situation and cause of the aerocele, and the progress of the case with complete recovery. The collection of air was extradural, and underneath the frontal lobe. The air was obviously forced through the fracture in the frontal sinus by the act of sneezing. These cases are usually complicated by meningitis, but in this there was an absence of infection throughout. There was no history of rhinorrhœa. Finally, this complication of fractures of the skull is not described in surgical text-books.

Dr. Goss makes the following observations: "In the light of after-events, the result and findings of the operation, and a careful re-examination of the radiograms, it is obvious that there is a layer of brain substance lying between the vault of the skull and the collection of gas—that is, under the frontal lobe. If I could have recognized this before, rather than after, it would have shortened and simplified the operation."

Mr. Bernstein, in his comments, suggests that the operation could have been improved by an exploration through the frontal sinus and by plugging the opening with Horsley's wax, had the situation of the aerocele been correctly diagnosed before the operation.

A review of the literature relating to cranial aerocele can be found in an article by W. E. Dandy.[1] R. D. Mothersole[2] also reported a case of fracture of the skull followed by presence of air in the cranial cavity.

I am indebted to Dr. Goss and Mr. Bernstein for their collaboration in this case.

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FEMORAL HERNIA IN A BOY OF 5 YEARS.

By ERIC I. LLOYD,

SURGEON TO THE HOSPITAL FOR SICK CHILDREN, GREAT ORMOND STREET, LONDON.

Femoral hernia is extremely rare in children, and only one example occurred in three years at the Hospital for Sick Children, Great Ormond Street. During the same period 715 inguinal hernias were admitted for operation. Other statistics[1] put the incidence at 0·7 per cent. Girls are much more commonly affected than boys, and Fraser states that he has "never met with an instance of the error in a male child". Everyone who operates upon a large number of hernias in children meets an occasional femoral example in girls, but it seems worth recording its incidence in a boy of 5 years.

The child when seen at the Princess Louise Hospital for Children, Kensington, was obviously suffering from a large right femoral hernia. Operation was performed on Sept. 30, 1930, by the inguinal route, and a sac nearly three inches long was brought up from the crural canal. It was found to be empty, and was transfixed, ligatured, and excised. The inguinal canal was examined, but contained no sac. Recovery was uneventful.

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A CASE OF FIBROMA OF THE MESENTERY.

By CECIL P. G. WAKELEY,
SURGEON TO KING'S COLLEGE HOSPITAL, LONDON.

Tumours of the mesentery are so rare that they may be looked upon as pathological curiosities. They may assume large proportions without giving rise to any marked symptom or causing intestinal obstruction. The case recorded here is of interest on account of the large size of the tumour, which weighed 4 lb. 2 oz., and yet the patient was caused but slight inconvenience.

History.—Frederick P., a bachelor, age 54, a decorator by trade, was admitted to King's College Hospital, in April, 1930, complaining of a lump in his belly. He first noticed it about three years ago, when it was roughly the size of a cricket ball. During the last year it has gradually increased in size. There was no pain associated with the lump, but the patient has been obliged to take salts in increasing quantities in order to keep his bowels open. During the last three months previous to admission to hospital he suffered from indigestion. He has always enjoyed good health, and states that he is perfectly fit except for slight indigestion. He has not lost weight. He lived in Australia for seven years about thirty years ago. There was nothing of importance in his past or family history.

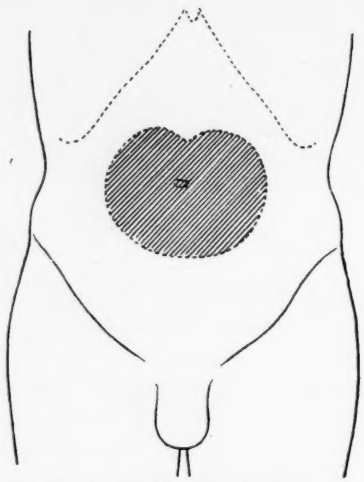

Fig. 504.—Showing the position of the tumour.

On Examination.—On examining the abdomen a small para-umbilical hernia was discovered. A large hard tumour could be palpated under the abdominal wall in the umbilical region (*Fig.* 504). It measured about eight inches across and about six inches from above downwards. A small notch was palpable at its upper margin in the mid-line. The tumour was dull on percussion, but the dullness did not extend into the areas of dullness caused by the liver or spleen. It was hard and smooth, and no thrill or fluctuation could be elicited. It was freely movable in the abdomen in all directions. There was no obstruction to the gut, the patient's bowels were moved each day, and on no occasion was visible peristalsis observed.

Operation (April 10).—Operation was performed by my colleague, the late Mr. T. P. Legg. The abdomen was opened by a right paramedian incision eight inches long. On opening the peritoneal cavity a large solid swelling was disclosed lying in the mesentery of the small intestine; one loop of the small bowel was tightly stretched over the middle of the swelling (*Fig.* 505). The loop of intestine involved was about ten feet from the duodenojejunal junction. In order to remove the tumour it was necessary to resect the attached loop of small intestine. A V-shaped enterectomy was performed including the tumour. The two cut ends of the small intestine

were then stitched together, and the cut ends of the mesentery sutured to each other. A drainage tube was inserted down to the line of anastomosis. The abdominal wall was closed in layers.

The patient progressed well for the first twenty-four hours after the operation, when he began to vomit, and his abdomen became distended. A stomach wash-out was given, and 1 c.c. of pituitrin was injected hypodermically. On the fourth day after the operation 20 c.c. of anti-gas-gangrene serum were given. However, the patient gradually sank, and died on the fifth day following the operation.

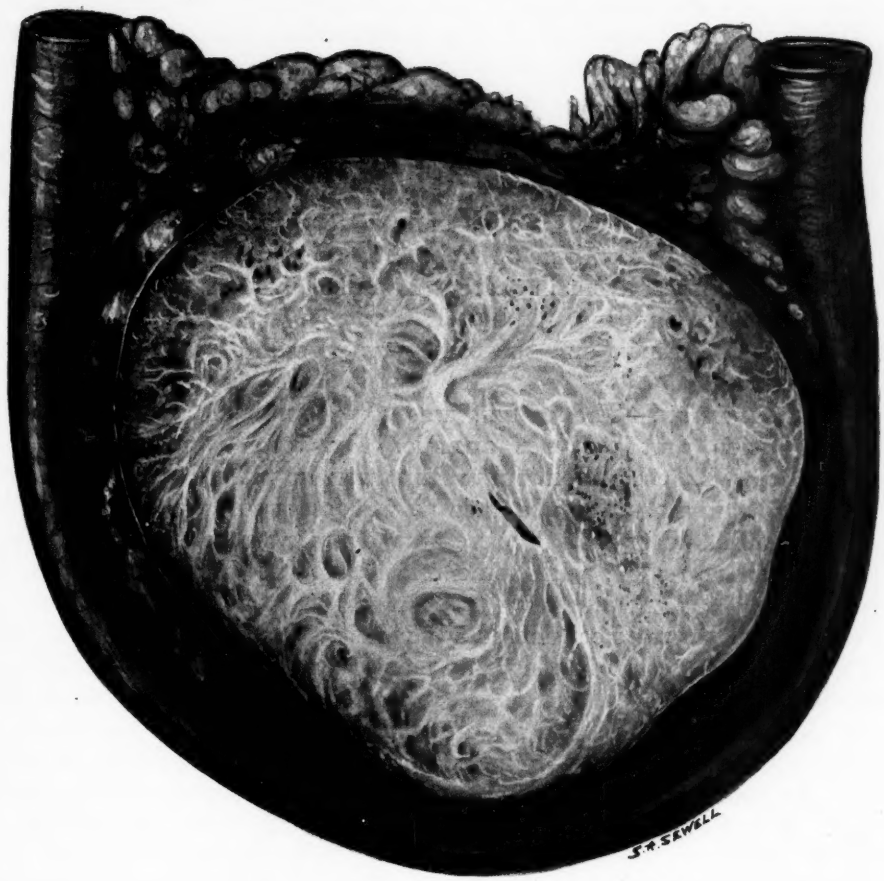

FIG. 505.—The tumour after removal. ($\times \frac{3}{4}$.)

POST-MORTEM.—At the autopsy the cause of death was found to be paralytic ileus caused by a large hæmatoma at the site of the anastomosis. The hæmatoma caused the obstruction and the ileus followed.

The specimen weighed 4 lb. 2 oz., and the cut surface of the tumour was white and hard and characteristic of a fibroma. Microscopically the tumour is a hard fibroma. It is moderately cellular and it is to some extent infiltrated with polymorphonuclear leucocytes and lymphocytes, chiefly near the blood-vessels. The blood-vessels are fairly numerous and are well formed.

A PARTIALLY OSSIFIED FIBROMA OF THE STOMACH WALL.

By H. G. G. NELSON,

SURGEON TO THE ROYAL SOUTH HANTS AND SOUTHAMPTON HOSPITAL.

On Feb. 1, 1928, I saw in consultation a male of 61 years who had suffered during many years from indefinite abdominal pain.

History.—The pain was intermittent, had no special relation to the ingestion of food, and there were periods during which he was well, and free from all symptoms. Apart from his gastric disturbance he had always enjoyed good health and had had no serious illness. Fifteen years previously he had what may have been an attack of melæna, but it was not accompanied by hæmatemesis. He had been troubled with eructations and flatulence, but had never vomited. In recent years he had suffered from several attacks of abdominal pain, chiefly in the neighbourhood of the umbilicus; each attack lasted three to four days and was accompanied by slight rise of temperature. When I saw him on Feb. 1, he stated that he had had pain during four days, intermittent in character and localized around the umbilicus. There had been no vomiting, his bowels were regular, though he was in the habit of taking aperients, and the urine was normal. His temperature was 100°, the pulse 80.

On Examination.—The patient was a well-built man of a somewhat pallid complexion, but was not anæmic. His teeth were artificial. The tongue was coated. On abdominal examination he referred to the umbilicus as the seat of the pain. The abdomen moved freely on respiration and there was no abdominal distension. There was definite tenderness on palpation over the appendix region, with some relative rigidity. Rectal examination was negative.

First Operation.—I considered appendicitis the most probable diagnosis and that the attack was subsiding, and elected to wait before operating. He did not improve, however, and as the pain continued, I operated two days later by a right iliac incision. The appendix was definitely inflamed, thickened, and fixed by adhesions—indubitable evidence of previous inflammatory trouble. Appendicectomy was performed and the wound closed without drainage. I was satisfied that I had correctly diagnosed and treated the trouble.

The patient was doing well, when on Feb. 5, at 8 p.m., seventy-eight hours after the operation, he vomited a small quantity of bright-red blood, and at 10.30 p.m. suddenly collapsed and was obviously suffering from severe internal hæmorrhage. He was treated with intravenous injection of normal saline, the administration of horse serum, etc., and slowly recovered. Two days later there was definite melæna, and a further copious black stool some three days afterwards. I now diagnosed a probable duodenal ulcer, and decided to operate again as soon as his general condition justified interference.

Second Operation (Feb. 27).—The abdomen was opened to the right of the middle line, in the epigastrium. I was surprised to find no evidence of duodenal ulcer, but immediately felt a lump, apparently movable, situated

in the smaller peritoneal sac above the stomach. Through an opening made in the gastro-hepatic omentum by blunt dissection, the tumour was brought into view. It was white in appearance, somewhat like cartilage but less translucent, round in outline, of stony hardness, and in size larger than a golf ball, though not so large as a tennis ball. It was freely movable, except for an attachment high up on the smaller curvature of the stomach. By careful dissection the tumour was freed and removed. On further examination I found an ulcer on the smaller curvature towards the cardiac end of the stomach. It was impossible to excise this, and I decided that an anterior gastrojejunostomy was the quickest and best treatment; this was consequently performed.

The patient stood the operation well, and through a normal convalescence made an excellent recovery.

Pathological Report.—The excised tumour was spherical, densely hard, dull-white in colour, with a smooth surface, but roughened in places where it had been attached to the surrounding structures, and particularly where it had been continuous with the floor of the gastric ulcer. Section of the tumour disclosed in its interior a hard substance, apparently bone. Microscopic examination of the tumour confirmed the naked-eye suspicion of the presence of bone. As seen in the photomicrograph (*Fig.* 506), the main mass of the tumour is fibrous, and clearly delimited within it are masses of bone containing few bone-cells not arranged in Haversian systems, nor has the bone the normal lamellar arrangement. The transition from fibrous tissue to bone in the photomicrograph is abrupt, as if the bone formation had been of long standing in the portions of tumour examined and was not progressing. Within the fibrous tissue masses of cells with an acinar arrangement, whose characters are better shown in *Fig.* 507, indicate an invasion by a glandular structure constituting an adenocarcinoma.

Subsequent Progress.—It is now (January, 1931) nearly three years since the operation, and the patient remains in good health apart from occasional flatulence. There has been no return of the pain and no recurrence of melæna. He has not lost weight and is able to attend to his daily duties.

COMMENTARY.

The etiology of this curious combination of a mixed epithelial and mesoblastic tumour is not at first sight obvious. Histologically the tumour is a fibroma containing a considerable quantity of fairly well developed regular cancellous bone, and at the same time the tumour is being invaded by a malignant epithelial growth. The fibrous tissue is well formed and regular, and towards the periphery forms a fibrous capsule with definite circumferential limitation. Central to the fibrous capsule, bordering on it, lies the cancellous bone, which has a definition and regularity which is not always present in ordinary heterotopic bone. The epithelial element which invades the tumour is composed of columnar cells, clear and fairly regular in size, though many have two nuclei, and these cells are arranged for the most part in acini or masses. The cells extend between the tumour fibres and into

FIG. 506.—Photomicrograph showing a fibroma of the gastric wall strictly delimited from an area of atypical bone and invaded by an adenocarcinoma. (× 110.)

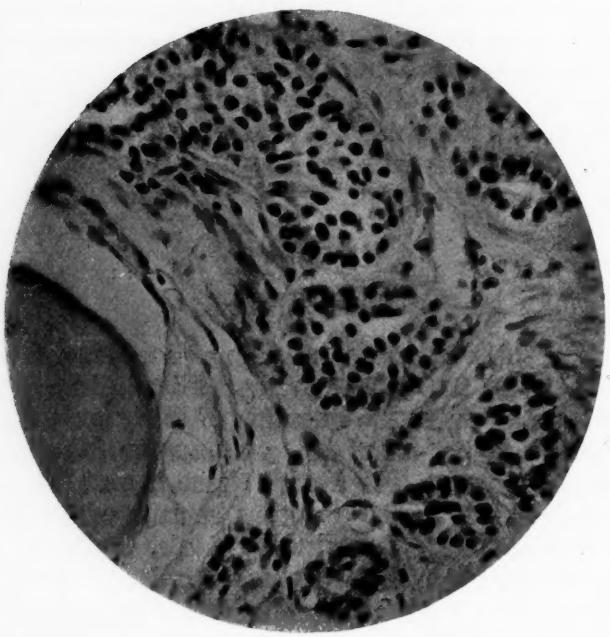

FIG. 507.—Photomicrograph showing the fibrous matrix of the tumour surrounding an area of smooth bone and invaded by cells having the characters and arrangement of an adenocarcinoma. (× 300.)

the cancellous spaces, and this invasion is not now accompanied by any obvious increase of vascularity.

There seem to be three explanations possible—that the tumour may be: (1) A teratoma; (2) A fibroma the seat of an epithelial metastasis; (3) A fibroma being invaded from the stomach by an adenocarcinoma.

1. As regards the teratoma, this might be either primary or metastatic. A primary teratoma attached to the stomach projecting into the smaller peritoneal sac and undergoing an epiblastic malignant degeneration is a possibility, but would be a very rare if not a unique occurrence. Were the teratoma metastatic, its position would be unusual, nor would a metastasis of this size be likely to be single. There is no evidence of a primary teratoma elsewhere—for example, in the testis or in relation to the autonomic nerves or sympathetic ganglia. In the parts of the tumour examined there was no remnant of other somatic tissue besides fibrous connective tissue, bone, and epithelium.

2. A fibroma of the stomach is, of course, a recognized occurrence, and little subserous fibromata, quite apart from anything in the nature of neurofibromatosis, are common; but that a subserous fibroma should attain any great size is certainly not usual. Such a tumour, moreover, would be a pure fibroma, and a carcinomatous metastasis into it without metastases elsewhere would be an extraordinary occurrence. Further, it would not explain the presence of the cancellous bone within the tumour. In any fibroma which had long ceased to grow and had become centrally to a great extent avascular so that the fibrous tissue was functionally dead, calcium salts may be or are ultimately deposited, and if revascularization takes place heterotopic bone may form. But the less vascular the tumour, the less likely is it to become the seat of a metastatic invasion. Therefore this explanation of the tumour's histology seems highly improbable.

3. The third possibility therefore seems the most likely—namely, a fibroma of long duration which has undergone central ossification and has comparatively recently become locally invaded by glandular elements from the gastric mucosa. The gastric symptoms of which this man complained were of at least fifteen years' duration and had at times been in abeyance during many years. It is possible there may have been originally a gastric ulcer with threatened perforation, and therefore with a development about its base of inflammatory connective tissue. It is common knowledge that such inflammatory masses may attain a considerable size, though to form a spherical, almost pedunculated, tumour the size of a golf ball is most unusual. It seems almost possible that the gastric ulcer may have developed—fortuitously perhaps—on the mucosa subjacent to a pre-existing neural or subserous fibroma. That the fibroma, inflammatory or pre-existing, might be invaded by an adenocarcinoma originating in the base of an old gastric ulcer which had recently given rise to attacks of hæmorrhage seems a very feasible explanation. It is not so difficult to envisage an inflammatory fibrous mass being the seat of a calcium deposit as it is to understand this occurring in a slowly-growing gastric true fibroma, though there is no doubt that ossification of true fibromata occurs. The inflammatory fibrous tissue has the property of the cicatrix contracting and diminishing its capillary circulation

and thus rendering itself liable to the deposition of calcium salts. With the epithelial invasion from the stomach, or even before then by simple irritation of the calcareous deposit, a reactionary increase of blood-supply might take place, and, meeting the local excess of calcium, would form heterotopic bone. Though the bone is more regular than heterotopic bone usually is, it seems this explanation best fits the clinical facts as well as the histological findings.

For assistance in the investigation of the tumour I am indebted to Mr. D. M. Greig, Conservator of the Museum of the Royal College of Surgeons of Edinburgh; and my acknowledgements are due to Mr. Tom Hamilton, of the Laboratory of the Royal College of Physicians of Edinburgh, for the photomicrographs which illustrate this article.

TRAUMATIC RUPTURE OF THE AORTA.

By S. J. H. GRIFFITHS,

ASSISTANT SURGEON AT THE GENERAL HOSPITAL, BRISTOL.

Research into the literature of the last ten years reveals records of a number of cases of rupture of the aorta. The majority are associated with arterial disease—namely, atheroma or aneurysmal dilatation. There are but few

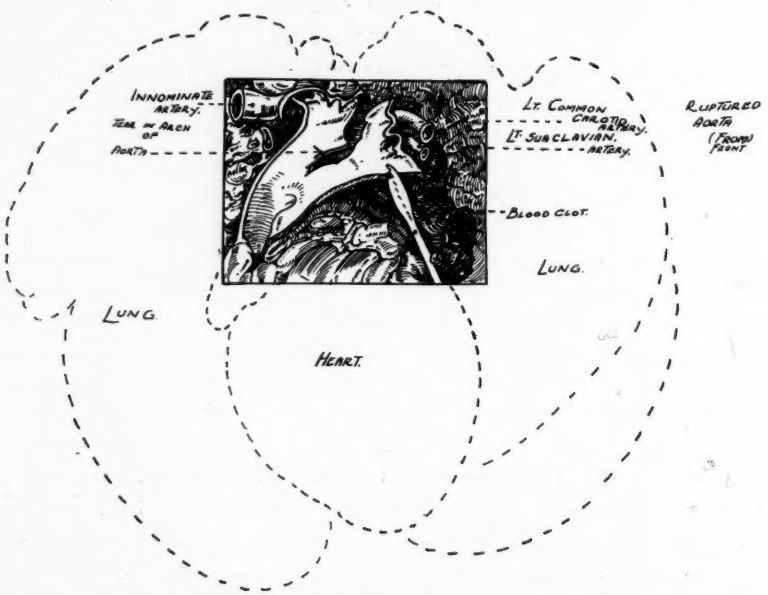

Fig. 508.—Appearance of the aorta post mortem, anterior view.

cases of traumatic rupture, and those described have all been associated with grave thoracic injuries. Kemp[1] described a case occurring in a male of 46 who had been struck on the head and chest by a large stone fly-wheel. The post-mortem examination showed a large abrasion over the sternum, much subcutaneous extravasation of blood around the pectorals, a fracture of the sternum, and a transverse rupture of the aorta just above the aortic valve.

The following case occurring in a young man without any evidence of arterial disease, and with no apparent injury to the chest wall, is worthy of record.

H. A., age 26, was brought in dead to the Bristol General Hospital on Aug. 26, 1929, with the history that he had been involved in a motor-cycle accident.

POST-MORTEM EXAMINATION.—The findings at autopsy were as follows :—

External Appearance.—A young male subject with numerous abrasions upon the forehead and face. The jaw was broken, the nose split, the left tibia and fibula were fractured in three places, and the right wrist was dislocated.

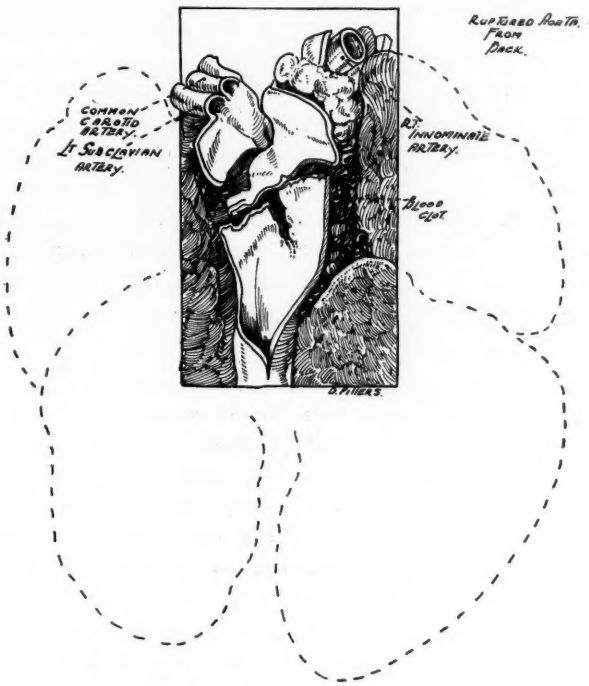

FIG. 509.—Appearance of the aorta post mortem, posterior view.

Internal Examination.—Heart : Myocardium and valves were normal. Lungs : Healthy. Aorta : There was no evidence of disease. At a point beyond the origin of the great vessels there was a T-shaped rupture of the aorta with considerable extravasation of blood around. There was no free fluid in the pleural cavity, no fracture of the skull, and no injury to the abdominal viscera.

There is, I think, but little doubt that this was a case of rupture of the aorta occurring by contrecoup. The diagrams (*Figs.* 508, 509), for which I am indebted to Miss D. Pillers, show the condition of the aorta post mortem.

REFERENCE.

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A THORACIC DERMOID.

By D. E. ROBERTSON,
HOSPITAL FOR SICK CHILDREN, TORONTO.

History.—The patient, a boy of 7, had always been well until May, 1928. At this date he became ill and a diagnosis of influenza was made. His recovery from this was fairly prompt, but he began to complain of pain in the right chest. The pain came on at intervals, and at times was so severe as to require sedatives. Pleurisy was given as the explanation. This pain, however, ceased after a few weeks and never returned. Toward the end of June, 1928, the mother noticed a swelling of the right side of the chest. The physician considered the bulging was due to fluid in the chest. Throughout the summer of 1928 he was miserable with cough and fever and a considerable loss of weight. Early in December an aspiration was done and some fluid obtained. This was sent to a laboratory for examination and was reported "no T.B."! It is to be noted that this opportunity for a correct diagnosis was missed. Two weeks later, on Dec. 17, a rib resection was done and a cavity drained. The result was not satisfactory in clearing up the condition, and another operation was undertaken, with no better results. X-ray pictures taken during the foregoing period showed a uniform increased density of the whole right thorax below the second rib (*Fig.* 510).

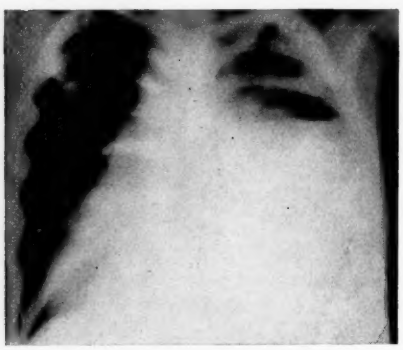

Fig. 510.—Radiograph of chest before operation.

On Admission.—He was brought to the Hospital for Sick Children, Toronto, in May, 1929, in an emaciated condition. He had a discharging sinus in the right chest at the level of the seventh rib. The temperature ranged as high as 101° in the evenings, and his pulse-rate was 90 to 120.

On Examination.—Examination of the chest revealed a bulging of the right chest with a lack of movement. The bulging was lateral about the sixth or seventh rib, and a sinus was present at the most prominent part. The percussion note was flat all over the right chest except at the apex, where there was a normal resonance to be heard. No breath-sounds were to be heard on auscultation over the area of flatness. It was decided to fill the sinus with an opaque substance and to X-ray the chest, in the expectation of outlining the cavity.

X-ray Examination.—A skiagram was taken after 10 c.c. of sodium iod. solution had been injected into the sinus; the report was as follows:—

On the right side the apex is clear, but from the level of the second rib anteriorly down to the diaphragm very heavy shadows are shown. Most of the dense area lies adjacent to the heart, and separated from the lateral wall by a distance of about one inch except at the sinus, which seems to join it

at the exterior on its postero-lateral aspect. The sinus and the small abscess pocket which it drains are filled with sodium iodide solution. Although the injected cavity and the large dense mass in the centre of the chest appear to be in contact, none of the opaque solution appears to have entered the latter. It is probable that the opaque areas—not injected—are large abscess cavities which are not draining through the injected one.

Diagnosis.—A chronic empyema with incomplete drainage, due to a loculated arrangement.

Operation (May 27).—Under general anæsthesia an incision was made in the region of the old sinus, in the mid-axillary line about the sixth and seventh ribs. Incision was deepened to the ribs, where a great deal of new growth had taken place, so that the ribs had fused above and below. A rib resection of about two inches of what was taken to be the seventh rib was done. The region of the sinus was explored with the finger and found to lead posteriorly. Much pus exuded, and at the bottom of the cavity, which had smooth walls, there was felt to be a very hard ridge, smooth and rounded. Anterior to this and between it and the chest wall there was a mound of tissue. A needle was put into this and about 10 c.c. of sero-sanguineous fluid removed. There was great difficulty in determining the nature of the mass. On sponging and cleaning the cavity many hairs were seen to be growing from it. The diagnosis was then clear. The condition of the patient being fairly good, incision in the chest wall was extended considerably and further rib resection done, and a large mass about four and a half to five inches in diameter was delineated in the right thoracic cavity. This was almost round in shape, and could be enucleated fairly readily. The adherent strands to the diaphragm were clamped and cut and tied, as well as many adherent strands to the pleura near the region of the hilus of the lung. The whole mass being enucleated and removed, it was with difficulty delivered through the wound. It was seen that what had previously been taken for an old empyema cavity was a sinus of the cavity inside this mass from which pus had exuded. There was a large space left in the thorax from where the mass had been taken. After all the strands had been tied off and those from the region of the hilus oversewn, no bleeding was noted. Two tape sponges were left in the cavity, the skin wound was sewn up in part of its extent with interrupted silkworm-gut sutures, and left freely communicating with the cavity at its centre. During the latter part of the operation the patient was receiving continuous intravenous saline, and following the operation was transfused with whole blood. His condition was only fair on return to the ward.

Following the operation there was considerable shock, but progress was uneventful. Two days after the operation the large sponges were removed from the cavity. It was clear, but a considerable discharge occurred and persisted for about four weeks. A marked auricular fibrillation occurred two days after operation, but concentrated tincture of digitalis corrected this, and recovery was quite uneventful.

A skiagram taken on May 31, 1929, is reported upon as follows :—

Some large sections have been removed from the sixth and seventh ribs of the right side and a large-calibre drainage-tube has been inserted. The extensive mass which was shown adjoining the right hilum has disappeared,

although there are still some more extensive shadows there than normal. Heavy peribronchial thickening extends upwards into the apex, where there is still some lung functioning. The rest of the right lung is apparently completely collapsed, and a large amount of air fills the cavity in which a drainage-tube has been inserted.

Pathological Report.—This report states that the gross specimen consists of a large rounded mass the size of a large grape-fruit, measuring about 12 by 11 cm. in diameter. The mass is definitely encapsulated; the external surface is fairly smooth, except for the presence of a few fibrous tags. Towards one surface is an irregular opening about 4 cm. in diameter, which leads into a cavity in the interior of the mass. Section through the mass reveals that this cavity is of a most irregular nature, having in places a very thin wall about 2 or 3 mm. in thickness, while elsewhere the wall is from 7 to 8 mm. in thickness. The cavity is lined for the most part with a pinkish-white velvety wall, growing from which are numerous fine hairs. In the cavity there is considerable sebaceous material. The wall of the cavity shows great variation in structure. The greater portion of it consists of a yellowish fatty material, elsewhere there are thin pearly-white areas, patches of cartilage (*Fig.* 511).

Microscopic Examination.—Sections were cut from a number of areas showing various pictures in the gross. In these different areas a great variety of tissue structures can be seen, These include connective tissue, muscle, blood-vessels, cartilage, nervous tissue, and epithelial structures. The epithelial structures include sebaceous and coil glands, squamous epithelium, and hair-follicles. In places there are isolated groups of small, deeply-staining cells resembling cells of ependyma. There is no evidence of rapid proliferation or of malignancy.

Fig. 511.—Tumour removed from chest, with scale in inches.

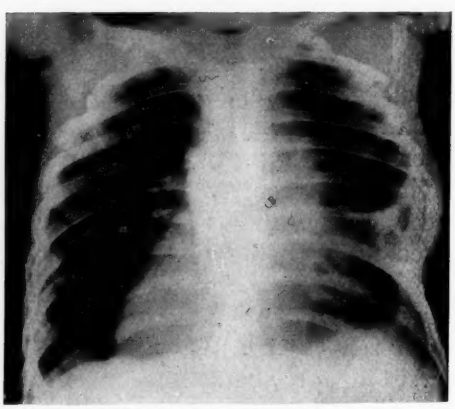

Fig. 512.—X-ray appearance of chest six months after operation.

Subsequent Progress.—The patient's wound finally closed in August, nine weeks after operation. The report of the X-ray taken on Sept. 13, 1929, is as follows :—

Heart and mediastinal structures all appear to be displaced considerably towards the right side of the chest, creating dense shadow in all of the central zone of that side of the chest. The peripheral region of lung appears to be functioning except at the base, where the diaphragm is riding abnormally high and the costophrenic angle is apparently filled up with adhesions.

Dec. 17, 1929.—The lad is now leading a normal life. He has been back at school for six weeks and is apparently well. There is little asymmetry of his chest and there is good resonance over the right side. (*Fig.* 512.)

DISCUSSION.

1. The X-ray pictures did not show the presence of any cartilage or bone.

2. The bronchitis present was mild and no sputum was produced; the breath was sweet, indicating no bronchial opening into any abscess cavity.

3. Deformity and bulging of the chest on the affected side denoted a condition of long standing.

4. A positive diagnosis of dermoid tumour could be made in one of two ways only: (*a*) The fluid obtained at aspiration would have, under close investigation, yielded the correct diagnosis; (*b*) Exploratory opening, with the identification of tissue foreign to the lung.

5. The line of cleavage in this tumour was readily followed. The tumour was so solid that its size could not be diminished by a drainage of any cyst that might have been found in its make-up.

6. A transfusion of blood during the operation was necessary to save this life.

7. The very large cavity left in the right thorax in a boy of 7 required no treatment other than dependent drainage to close in nine weeks.

AN UNUSUALLY LARGE INTRATHECAL SPINAL TUMOUR.*

By LAMBERT ROGERS,

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This tumour appears to be worthy of record, not only because of its unusually large size, but also because of its position and rapid growth, and the clinical course of the patient before and after its removal. It was removed from a man of 23, weighed 9·5 grm., measured 44 mm. in length, and at its widest part 23 mm. in breadth, and was entirely intrathecal and extramedullary. Originating from the second right cervical nerve, it lay in front and slightly to the right of the upper part of the spinal cord, and extended upwards in front of the cord as far as the foramen magnum. The first symptoms had arisen only four months before operation, at which time the patient was quadriplegic, and its removal was followed by very rapid recovery of function.

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* From the Surgical Unit, the Welsh National School of Medicine, the Royal Infirmary, Cardiff.

HISTORY.—In March, 1930, a young marine engineer noticed that he was unable to grip a hammer properly owing to weakness of his right hand. The weakness became greater and gradually extended to the whole arm. Early in May he began to limp because of weakness in the right leg and dragging of the foot. By the beginning of July the right arm was quite useless, the left hand and fingers had become weak, and the right leg stiff. Involuntary contraction, which three weeks before had begun to affect the right leg, now extended to the left leg also, and there was difficulty in commencing micturition. At times he noticed tingling in the right arm, and a feeling of 'pins and needles' in the right leg, especially in the morning just after awakening, but there had never been any pain.

ON EXAMINATION.—The patient was a well-built man with a wasted and spastic right upper limb, adducted at the shoulder and flexed at the elbow. The lower limbs were less spastic and in extension, with Babinski plantar reflexes, ankle-clonus, and exaggerated knee-jerks. The arm-jerks were also exaggerated and the abdominal reflexes absent. He was, with difficulty, able to walk, the gait being not unlike that of a hemiplegic, the right leg stiff, dragging, and circumducted, the right arm hanging by the side and semi-flexed at the elbow.

Pain sensation (pin-prick) was diminished throughout both arms, over the left side of the trunk, the left leg, and the right side of the trunk as low as the twelfth thoracic segment. Over an area corresponding to this distribution also he was unable to distinguish finer differences of temperature. Below the twelfth thoracic segment on the right half of the body and throughout the right leg, however, pain sensation and temperature discrimination were undiminished. There was slight impairment of light touch over the body and all four limbs, and a greater degree in the right arm and hand, the hand being almost anæsthetic. There was not, as might have been expected, any disturbance of the cervical sympathetic. The paralysis, most marked in the right arm and leg, with normal pain and temperature sensations in the same leg, and diminished pain and absent discrimination for the finer degrees of heat and cold in the left leg, constituted a partial Brown-Séquard picture.

DIAGNOSIS.—The Wassermann reaction in the blood and cerebrospinal fluid proved to be negative, and lumbar puncture produced colourless acellular cerebrospinal fluid, the protein content of which was slightly raised. Professor A. M. Kennedy, under whose care the patient was admitted, diagnosed a spinal tumour high in the cervical region.

On Aug. 6 cisternal puncture was performed and lipiodol injected into the subarachnoid space. X-ray examination immediately, and at 6-, 24-, and 48-hour periods afterwards, showed that practically all the lipiodol remained in the cistern. In the 24- and 48-hour plates, only a very small blob, slightly larger in the 48-hour plate than in the 24, was apparent at the lower limit of the meninges. There was thus almost complete blockage of the spinal subarachnoid space at the level of the foramen magnum.

OPERATION (Aug. 14).—Under intrapharyngeal ether anæsthesia, the posterior arches of the atlas and axis and the laminæ of the 3rd and 4th cervical vertebræ were removed and the under surface of the occipital bone exposed. On opening the dura mater the appearances were those shown in

Fig. 513. The tumour lay to the right and in front of the cord, which it displaced backwards and slightly to the left. The tumour was crossed posteriorly by a slip of the dentate ligament. This slip was divided, as were also the posterior fascicles of the second cervical nerve on the right side. The tumour was then found to arise in connection with the right second cervical nerve, which was therefore divided at its exit in the intervertebral foramen. The cord was gently rotated, using the cut slip of the dentate ligament, and a large part of the tumour was thereby exposed extending upwards as far as the foramen magnum and for some distance downwards along the anterior face of the cord. After dividing the involved second cervical nerve, the tumour was found to be free, and without difficulty was completely removed in two pieces, which together were found to weigh 9·5 grm. The wound was closed in layers, the edges of the dura mater being only loosely approximated by tying together the sling sutures that had been introduced in order to retract it.

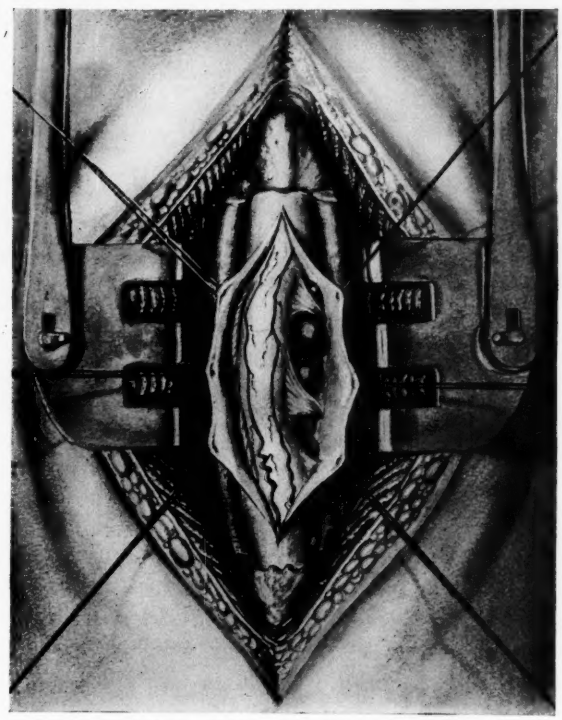
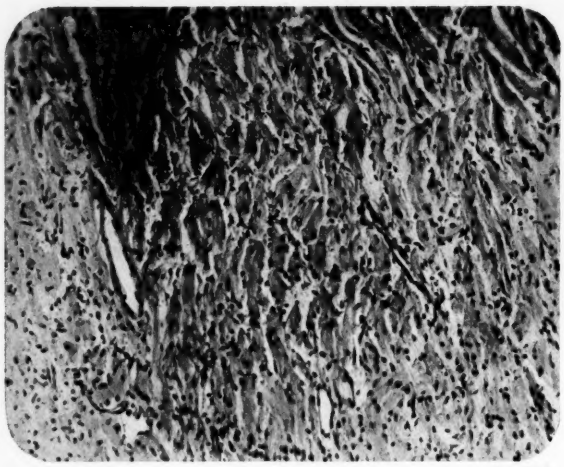


Fig. 513.—Appearance of tumour seen through opened dura mater. The greater part is in front of the cord, and the whole of it anterior to the dentate ligament, a slip of which can be seen crossing behind the tumour between two posterior nerve-roots. The cord is displaced backwards and slightly to the left.

After-history.—Convalescence was uneventful, primary union occurring. Functional recovery was plain within forty-eight hours of the removal of the tumour, by returning control over the fingers of the right hand. By the fifth day after operation the spasticity had disappeared from the arm, but was rather more marked in the legs. The patient could now extend the elbow, and finger movements were still freer. Eight days after operation he was able to hold a book in his hand while reading. On the thirteenth day he sat up in bed. Leg movements were now better, and he got up on the eighteenth day. By the twentieth day spasticity had completely disappeared from the legs, and the following day he commenced walking. Pain and thermal sensations had now returned, but there was still some blunting of light touch over the left side of the front and back of the trunk. The man was discharged, walking out unassisted, on the thirtieth day after operation.*

* It is now ten weeks since the operation, and he is returning to his work at sea.

PATHOLOGICAL FINDINGS (*Figs.* 514, 515).—The tumour consisted of loose myxomatous fibrous tissue and was devoid of nerve-cells or nerve-fibres. It was apparently a myxofibroma arising in connection with the sheath of the issuing nerve.



(× 85.)

FIGS. 514, 515.—Gross and microscopical appearances of tumour. The smaller part lay to the right and in front of the cord, but in front of the dentate ligament; the larger part entirely in front of the cord. The tumour, which was completely intrathecal, on removal weighed 9·5 grm.

Commentary.—If we exclude those long bedraggled and at times multiple tumours which extend throughout a large part of the spine and are sometimes seen in the lumbar region involving the cauda equina, this is the largest benign, circumscribed, intrathecal, and extramedullary spinal tumour of which I have had personal experience or have been able to find record. The rapid progress of symptoms was not typical of a spinal tumour, and rather suggested tuberculous disease as the cause of the spinal compression. The partial Brown-Séquard syndrome was of interest, because although we should expect this type of dissociation from lateral compression of the cord, it is rather unusual to find it in cases of spinal tumour, the reason probably being that a small lateral displacement of the cord by a tumour results in compression not only on the side of the tumour but also at the diametrically opposite point in the spinal canal, at which the cord is displaced against the bone. By the time the majority of laterally placed tumours manifest their presence hemi-compression has become bilateral compression. The greater diameter of the cervical region of the vertebral canal probably accounts for the occasional presence of the syndrome in cervical spinal tumours. I have seen it in one other case in which also the tumour was a cervical one.

The absence of paralysis of the cervical sympathetic is no doubt explained by the deep position in the cord and the relatively small size of the descending sympathetic fibres.

Following removal of the tumour with release of the compression of the cord the transient increase in spasticity in the legs was typical, and has been seen in a number of cases, but the rapid disappearance of spasticity in the

right arm without any preliminary and apparent increase appears to be unusual. Furthermore, the very rapid recovery of functional activity and sensation is remarkable, and probably the age of the patient, 23, was important in this connection, as in my experience a recovery almost as rapid occurred in a case of a girl of 16, paraplegic and incontinent from a tumour in the dorsal region, who three months after removal of the tumour was able to walk well and had complete control of the sphincters, while in older patients who have made as complete recoveries, up to ten months have been necessary for restoration of function to reach its maximum. The prognosis as regards functional restoration following the relief of spinal compression due to tumour depends upon the degree of damage done to the cord, the position and type of tumour, and the general condition of the patient; but the age of the patient is also highly important, and, other factors being equal, the younger the patient, the better appears to be the outlook to an extent which is much greater than might at first sight be apparent.

I am indebted to Dr. J. B. Duguid, of the Pathology Department of the Welsh National School of Medicine, for kindly reporting on the histology.

REVIEWS AND NOTICES OF BOOKS.

Plarr's Lives of the Fellows of the Royal College of Surgeons of England. Revised by Sir D'ARCY POWER, K.B.E. (Mil.), F.R.C.S., Hon. Librarian Royal College of Surgeons; with the assistance of W. G. SPENCER, O.B.E., M.S., F.R.C.S., and Professor G. E. GASK, C.M.G., D.S.O., F.R.C.S. In two volumes. Royal 8vo. Vol. I: Pp. 752 + xxvi. Vol. II: Pp. 596. 1930: Printed and published for the Royal College of Surgeons by John Wright & Sons Ltd., Bristol. Cloth, 42s. net; half bound, 57s. 6d. net.

THESE volumes contain an alphabetical series of biographies of those Fellows of the Royal College of Surgeons of England who have died since the institution of that order in 1843. They form a monumental work with no fewer than 2559 separate notices. The *Lives* is issued as two substantial volumes of 752 and 596 pages respectively, printed on good stout paper with excellent type, and nicely bound in cloth boards with tinted edges and lettering in gilt. The index is most satisfactory, for it gives not only the full name of each entry, but the dates of birth and death whenever that information is available. The plan uniformly followed with each biography or notice has been to record the full name with the date of birth and death and the qualifications or degrees with their dates. What a convenience it would have been if the reader had been relieved of all calculation and the age at death had been plainly stated! Naturally the notices vary much in length, but it appears that all who have left their mark on the history of surgery have been adequately treated. A list of important or principal publications is usually given, and among these there are often additional notes of interest. In each case the sources of information are appended to the notice, and very often interesting and illuminating information is conveyed in this way, while the student of biography is often referred to other works. The *Lives* is much more than a biographical dictionary, for in its 1348 pages is a record of the progress of surgery from the institution of the Fellowship down to but yesterday (1929). In some instances the opportunity has been used to present a summary of the work of a man and its influence on his time, and that is notably so in the case of the life of Lord Lister, where the reader will find an admirable summary, from an easily recognized pen, under the heading of "Antisepsis ensuring Aseptic Surgery", which brings the history of wound treatment down to the commencement of the Great War.

Altogether this is a great work and will remain as a monument to the industry of Victor Plarr and those who revised his notes, brought them up to date, and prepared them for publication. The very title-page is redolent of surgical history and suggests many queries which happily are answered by a perusal of the preface. Who was this Plarr whose self-made monument comes to our table in the form of these delightful volumes? Victor Gustave Plarr, who died in 1929, was librarian to the Royal College of Surgeons for thirty years. The traditions of that office were handed on to him by his predecessor, that great librarian James Blake Bailey, and during his long term the spirit of the place must have become part of his receptive nature, so that when it was suggested to him in 1912 by Sir John Bland-Sutton that he should endeavour to make a record of the lives of the Fellows, the task must have appeared congenial, though sufficiently colossal to have deterred one of lesser spirit. Of course from the outset it was hoped that the lives might ultimately be published, and this idea recurred from time to time, and the collection was examined from that point of view in 1923 when Sir John Bland-Sutton presided over the destinies of the College. Finally, under the presidency of Lord Moynihan, the

collection was prepared for publication by the devoted labours of Sir D'Arcy Power, Mr. W. G. Spencer, and Professor G. E. Gask. But the *Lives* might easily have been buried in obscurity—for is not that the fate of manuscripts "available for reference"?—had it not been for the generous bequest of £5000 made by the late Mr. Thelwall Thomas, of Liverpool, a member of Council, out of which the cost of publication was defrayed. That is the association between Thelwall Thomas and Plarr's *Lives*, and it would be better in a future edition to make it appear so on the title-page.

Many willing workers form the band who turn out a work of this magnitude, and in the preface due acknowledgement is made to the help contributed by those excellent library attendants Fusedale and Wood, who, like Plarr, are distinguished by their unfailing courtesy and willingness to help. After the illuminating preface comes a copy of the original Charter. It must be a surprise to those who scan this document for the first time to read in the first sentence, under the heading Charter—in capitals—"that the rank and file of surgeons have always been a wilful and perverse generation". To those of us who suffer under the incubus of that description it is a relief to find that this statement, so startling in its nakedness, is but a prelude to the Charter and not part of that notable document. A rearrangement of the heading on this page would prevent misunderstanding, though it might destroy what is perhaps meant to be the joint-editors' joke! After the Charter follows a list, culled from the *Lancet* of 1843, of the original 300 Fellows, arranged in order of seniority according to date of membership. In this list many notable names appear, and it will be interesting to Fellows not resident in London to notice how many representatives there were from the Provinces. To the list is appended the names of the towns from which the original Fellows were recruited, together with some other particulars of their location. Preceding the actual *Lives* is a statement of the underlying principle which has evidently guided the editors, for we are reminded that

> "To calumniate the Dead is Baseness:
> To flatter them is surely folly."
>
> *Dr. Johnson, in the Dedication of Charlotte Lemon's 'Shakespeare illustrated'.*

The lives themselves are intensely interesting, and one cannot complain if they appear to be monotonously appreciative, for how can it be otherwise when we learn that for the most part they have been culled from obituary notices published shortly after death? But in very many cases much time has elapsed since then, and recollection or contemporary record might have furnished some *obiter dicta* of the frailties to supplement the catalogue of virtues which are here spread as a feast before posterity. Even a few more personal characteristics would have been welcome and have made these records, excellent as they are, still more human. What a man looks like, the details of his private life, and often the cause and manner of his death, are all alike interesting, though some may think appertaining too much to gossip. But as it is intended to issue a supplementary volume every ten years, corrections and additions are invited, and those who can help to make these records more complete, more accurate, and more intimate are asked to send such particulars as they may have to the Librarian of the Royal College of Surgeons at Lincoln's Inn Fields, London, W.C.2. A few random comments on individual lives may illustrate what is meant.

The notice of Victor Horsley is one of the best in the book, but it is difficult to gather from it even an inkling of his well-known idiosyncrasies. There is no mention of his abhorrence of alcohol, and it would be consoling to some who are less idealistic to know that he was addicted to sweets, which he ate in great quantities. The nicety, even beauty, of his operations on animals will always remain an outstanding memory for those who were privileged witnesses. His kindness to those for whom he took a liking was extraordinary, and many who came in contact with him on active service will remember the many ways in which he endeavoured to help them. It may savour of flippancy to mention that after the funeral of this

very earnest teetotaler and prohibitionist in Amarah on a hot stuffy evening in July, when the temperature during the day had reached 118° F. in the shade, there was a regular stampede to the nearest messes where thirst could be appropriately and pleasantly quenched!

In the notice of Jordan Lloyd, no mention is made of his most valuable paper on "Injury to the Pancreas: A Cause of Effusions into the Lesser Peritoneal Cavity" (*Brit. Med. Jour.*, 1892), which contains practically all that we know to this day about pseudo-cysts of the pancreas. His skill as a surgeon was no more remarkable than the simplicity of his technique, and his Address in Surgery at the British Medical Association in Birmingham was a brilliant and justifiable plea for the many advantages of simple methods. In noting his two residences, it might have been said that he was one of the last to retain consulting-rooms in Broad Street, Birmingham, which he jocularly spoke of as 'the works'.

The notice of Macewen is very good. The barrenness of his classes in the early days probably gave us much of his brilliant work, for he was so devoted to duty that had he been occupied in teaching he would probably not have found the time for those researches which have justly made his name famous. He was accustomed to say that for years he was his only pupil, and in that we of his posterity are probably fortunate. Too little is said of that famous occasion in 1888 when he gave so notable an address before the Glasgow Meeting of the British Medical Association. What he had to say was so novel and at that time so rare, that the audience were as struck dumb until the end, when every man arose to his feet and cheered him to the echo. There is no mention in the article of his *Atlas of Head Sections*, but that was a work which occupied much time and care and deserves to be remembered. As the notice states, Macewen was a tall handsome man; but in the days when he was most sought after his beard was a striking characteristic, though in later years he shaved, which explains the striking difference in his rare portraits. The biography states that his eyes were grey, though the clearest recollection of the reviewer is of a horizon-blue tinge which somehow seemed to add to the peculiar piercing quality and helped to make his face so handsome and arresting when in his prime.

Of Charles Mayo, of Winchester, it has elsewhere been said that "he worked hard every day of his life and continued his hospital duties to the age of 83", which briefly but succinctly emphasizes the achievements of this grand old man. Frederick Page, of Newcastle, was a great personality, a brilliant operator and an entertaining clinical lecturer. He was a small man, quick in every movement, impatient, and often bad-tempered, but none the less kind-hearted and a staunch friend and always appreciative of enthusiasm in others. The note on his life overlooks the fact that in his declining years he found congenial employment in the exercise of his responsibilities as a Justice of the Peace. Sinclair White was a remarkable man. He began life in Sheffield as tutor in the Medical School, then became house surgeon, immediately afterwards Officer of Health, then general practitioner, from which he drifted into surgery, and ended as head of the surgical school of his adopted town! He was a great worker and better known for his success in the art of surgery and for his influence in the school and hospital than for any scientific attributes. In 1906 he acted as one of the Secretaries to the Surgical Section of the British Medical Association in Toronto. This was one of the most active sections of that memorable meeting, and the duties of the Secretary can seldom have ever been more onerous, though White discharged them punctiliously and well. He had a weak, ineffective voice and had great difficulty in making himself heard among any but the smallest audience.

It is interesting to know the manner of a man, and with regard to Henry Brunton Angus it would have been a better word-picture were we told that he was tall and good-looking, in his youth a footballer, and in his more mature years an enthusiastic fisherman. It was also a matter of local historical interest that for some years, in the earliest days of the development of X rays, he was in charge of the then primitive department.

Thomas Annandale was a big, powerful man who in every way cultivated the

style of his old chief, Syme, so that in his later years he came to be in appearance singularly like his old and admired master, with the bushy side-whiskers and the big spotted bow tie. His father, also Thomas, was for some years Honorary Surgeon to the Newcastle Royal Infirmary. The Edinburgh Annandale was wonderfully vigorous, and it was a delight to witness his operative dexterity and his neatness. Arthur Barker was an example, none too frequent in Britain, of a surgeon imported from another school in order to add 'new blood' to a stock which was ready for the stimulus. In the admirable account of this surgeon rather too little emphasis is laid on his articles on spinal anæsthesia, which were most admirable for their great detail and painstaking accuracy, and though the method which he advocated has been superseded, all who are interested in this subject would do well to read what he had to say on the matter. Thomas Bryant was one of the most handsome men of the Victorian era which he adorned, and those who knew him then and have grown accustomed to the rather *négligé* attire of the modern surgeon, must be struck by the difference in the ways of the times. It is sad to think that his declining years were darkened by financial embarrassment, but a relief to know that a civil list pension provided a welcome aid. In the otherwise good account of this surgeon, nothing is said about the early use of iodine in the treatment of wounds, which certainly preceded the modern practice of the use of that antiseptic. The inclusion of the name of Dennis Embleton, so long Nestor of the profession in Newcastle-upon-Tyne, comes as a surprise to those who remember him only as an accomplished and scholarly physician known to most students of the Newcastle school as the author of a history of its inception and early days. Many stories centre round his clinical teaching, and of him, doubtless as of others, it is recorded that in the days before chemical tests were generally used, he taught the students to dip a finger in urine and to taste it in order to detect the presence of sugar! George Yeoman Heath, also of the Newcastle school, was a great figure in his day: a handsome man, a brilliant surgeon, and an absorbing lecturer. Among the students he was noted for unpunctuality, and it is recorded that on one occasion when he arrived an hour late for lecture, all but one had left the precincts of the college. Unabashed, Heath took this student to the lecture room and entertained him for a full hour with a brilliant exposition of the subject in hand. He loved horses and was very proud of his spanking turn-out. Any notice to his memory should state his generous benefactions to the College of Medicine in Newcastle, for he left a sum of £6000 to found a residential hall and endow the chair of Comparative Pathology which is known by his name.

Many of the notices could not be improved, like that on Edward Cock, of whom it is recorded: "As a man Cock was the best beloved of the Surgeons who have been attached to Guy's Hospital. In his youth he was always known as 'Old Cock', in old age as 'Teddy Cock'." There are abundant examples from the same source, and the eponyms of D'Arcy Power and Lord Moynihan's most entertaining article on the earlier surgeons of the Leeds School will always remain as excellent models.

These random observations are merely to show that there are ways in which the admirable notices that form this collection may be made more interesting if not too gossipy. The general excellence of the *Lives* will excuse many little mistakes which have crept in, and the few occasions on which the obviously rough notes of the first compilation have been allowed to stand without that editing which would make them more polished. There are mistakes of commission as well as omission. George Ernest Herman's most useful and successful book was entitled *Difficult Labour* and not *Difficult Labours*. John Macewen is still surgeon to the Glasgow Royal Infirmary. Victor Horsley died at Amarah on the Tigris, not Amerah. Dexter is the right and not the left side of a picture. But these and many other slips are merely trivialities, and can easily be corrected in another edition. The work is a great joy, and there can be few who will not delight in browsing among the pages, and none who can afford to neglect this mine of information when searching for particulars about the 'Fellows' of yesterday or gleaning facts of surgical history.

Manual of Surgery for Students and Practitioners (Rose and Carless). By CECIL P. G. WAKELEY, F.R.C.S., F.R.S. Edin., Erasmus Wilson Lecturer, Royal College of Surgeons of England; Surgeon, King's College Hospital, etc.; and JOHN B. HUNTER, *M.C.*, M.Chir. (Cantab.), F.R.C.S., Assistant Surgeon, King's College Hospital, etc. Thirteenth edition. 9½″ × 6½″. Pp. 1592 + xii, with 664 illustrations in the text, 19 coloured, and X-ray supplement. 1930. London: Baillière, Tindall & Cox. 30s. net.

IT is only three years since we reviewed the last edition of this well-known text-book of surgery, and we would congratulate its editors on its continued prosperity. Mr. Carless writes what he describes as a valedictory preface, after having been chiefly responsible for the work for thirty-two years. Chapters on special subjects have been written or revised for this edition: bacteriology, by W. E. Carnegie Dickson; ear, nose, and throat, by V. E. Negus; the eye, by N. Bishop Harman; tropical surgery, by Sir Frank Connor; gynæcology, by Eardley Holland; and anæsthesia, by C. F. Hadfield. A new radiographic supplement by Graham Hodgson has been added.

This work has now established so unassailable a position as the first of its kind in this country that any praise for its general excellence and for the diligence of its present editors would be superfluous. If therefore we criticize some details, it is only in the hope of further perfecting future editions.

The statement that in congenital dislocation of the hip no true dislocation exists at birth is not borne out by museum specimens. Further, it is not correct to say that in cases of this deformity in patients over fourteen years of age operative treatment is useless, because very great improvement can be effected by a bifurcation osteotomy. Stabilization of a flail foot is said to be best effected by a subastragaloid arthrodesis, and no mention is made of the necessity of also fixing the mid-tarsal joint as in Naughton Dunn's operation. In fractures about the shoulder-joint we do not think that enough stress is laid upon the importance of abduction, and we think that the modern shoulder abduction splint should take the place of the obsolete Middeldorpf's triangle. In Pott's fracture the need for using a tilted shoe in after-treatment is not mentioned. In fractures of the os calcis the necessity for disimpaction with pin traction on the heel is omitted. In the description of the examination of the ureter and renal pelvis, we think that the use of uroselectan ought to have been included. We are glad that the chapter on amputation has been simplified and modernized and that the use of the guillotine operation is condemned. Among the forty-three excellent radiographs in the supplement, we regret that one should have been included showing a long screw in a fractured olecranon —a method of treatment which is surgically and mechanically bad.

The new edition has a larger page, many new illustrations of great beauty have been added, and the work will long remain most popular among students and practitioners.

The Science and Practice of Surgery. By W. H. C. ROMANIS, M.A., M.B., M.Ch. (Cantab.), F.R.C.S. (Eng.), F.R.S. (Edin.), Senior Surgeon in Charge of Out-patients, Surgeon to the Isolation Block, and Teacher of Practical Surgery, St. Thomas's Hospital, etc., and PHILIP H. MITCHINER, M.D., M.S. (Lond.), F.R.C.S., Surgeon in charge of Out-patients, Teacher of Operative Surgery, and Demonstrator of Anatomy, St. Thomas's Hospital, etc. Third edition. In two volumes, with 716 illustrations. Vol. I, General Surgery. Pp. 772 + x. Vol. II, Regional Surgery. Pp. 950 + x. 1930. London: J. & A. Churchill. 14s. each volume.

WHEN we reviewed the first edition of this work some two years ago we expressed the opinion that it would meet with approval because it appeared to be an endeavour on the part of two actively minded surgeons to record what they had seen and to advocate the treatment of which they had personal experience. It is, therefore, not a matter for surprise—though certainly one for congratulation—that a third edition should be called for within two years. Incidentally, we wonder why the authors depart from the practice, which has always appeared to us as being a good one, of dating their prefaces. We were not privileged to see the second edition, but as compared with the first the third edition is certainly a revision, and some

pages have been almost rewritten. If we do not agree entirely with some statements which are made, it is in general a question of detail, and we have nothing but praise for a certain dogmatism in the description of symptomatology and treatment which suggests that what we read is the personal experience and conviction of the authors. We would suggest that when undertaking the fourth edition the authors should first go through the present volume and cut out everything which they have not seen or done. This would make room for much-needed space for a more complete description of certain diseases, such as acute osteomyelitis, the teratomata, etc. Why do they still perpetuate prehistoric amputations of the lower limbs? Some of these are described under operations of historic interest; and a student, reading for an examination, might realize that this section could be ignored. But on the preceding page, amputations are described which certainly have no place in modern surgery. The figures are not well chosen—in many instances depicting conditions of extreme rarity and of no practical value. The representation of the complete armamentarium for an anæsthetist is surely unnecessary; and some figures, such as those of the ice-tong caliper and the Lane's plate, should be replaced by types in modern use. On the whole we regard this as the best British text-book of moderate size, but apart from this its popularity is enhanced by its extreme cheapness, which may provide an example worthy of imitation by other publishers.

Surgical Emergencies in Practice. By W. H. C. Romanis, M.A., M.B., M.Ch. (Cantab.), F.R.C.S. (Eng.), F.R.S. (Edin.), Surgeon to and Lecturer in Surgery at St. Thomas's Hospital, etc.; and Philip H. Mitchiner, M.D., M.S. (Lond.), F.R.C.S., Surgeon in charge of Out-patients, Teacher of Operative Surgery, and Demonstrator of Anatomy, St. Thomas's Hospital, etc. Demy 8vo. Pp. 608 + vii, with 158 illustrations. 1931. London: J. & A. Churchill. 18s. net.

This book has been produced by the authors of the well-known *Science and Practice of Surgery* to enable the practitioner who, from choice or necessity, has to deal with urgent surgical cases to obtain readily the necessary information in as concise a form as possible. On the whole the authors have succeeded in their object, though in places advice is given which is open to criticism and details are omitted which are of extreme importance. The preliminary chapter dealing with operative technique and pre- and post-operative treatment is clear and informative, and a useful section is included describing the arrangements necessary for an emergency operation in a private house. In the section on injuries to the soft parts special reference may be made to the section on burns and scalds, in which the importance of early cleansing of the burned area, so often neglected, is insisted upon and a definite line of treatment for such cases is provided. It is, however, to be regretted that insufficient stress is laid on the importance of avoiding contractures by their prevention in the early stages. Whitlow, in its various forms, is fully described and the necessity of early incision and of the proper planning of the incision is clearly indicated. The importance of an X-ray in the case of all fractures or suspected fractures from a legal point of view is, or should be, now well known, but the very important point is urged that on no account should treatment of a fracture be delayed because no X-ray is immediately available. Of individual fractures a sufficient account is given of the treatment of each type without unnecessary multiplication of methods. It is, however, disappointing that so little space is given regarding the possibility of the occurrence of Volkmann's contracture and its prevention in cases of injury in the region of the elbow-joint.

The chapters on abdominal emergencies are good, though some exception may be taken to the author's advice on the treatment of acute appendicitis; in the hands of experts, to delay operation, if a case is seen after forty-eight hours from the onset, *may* be good surgery; but to give this advice to general practitioners is bound to cause an avoidable mortality in such cases. The description of the after-treatment of general peritonitis is confusing, and it is doubtful whether it would be of much value to a man who had but little previous experience: a dogmatic statement of what to do in such cases would be of more value than a number of hints.

The blemishes that have been pointed out are outweighed by the excellence of the rest of the book, and it seems certain that it will become a valued addition to the practitioner's library.

Emergency Surgery. By HAMILTON BAILEY, F.R.C.S., Surgeon, Royal Northern Hospital, London. Volume I. Abdomen and Pelvis. Medium 8vo. Pp. 380 + xx, with 324 illustrations, some of which are in colour. 1930. Bristol: John Wright & Sons Ltd. 25s. net.

THIS is the first volume of a two-volume work upon emergency surgery and is devoted entirely to the abdomen and pelvis. The author's avowed purpose is to assist the "comparatively isolated surgeon" who is suddenly brought face to face with an acute abdominal catastrophe, and, on the whole, we may congratulate him upon having adequately achieved his intention. Precise details are given of each operative procedure described, each is usefully illustrated, and a certain degree of dogmatism, unsuitable in a more systematic treatise, may well be pardoned in a work of this kind. The methods described are fully up to date—in fact, it is a question whether some of the procedures advocated have been in practice sufficiently long to justify their recommendation to a "comparatively isolated surgeon". The 'delayed' (Ochsner-Sherren) treatment is strongly recommended as a routine practice in cases of acute appendicitis of over forty-eight to fifty hours' duration, though it is stated that this "must be carried out on the threshold of the operating theatre".

Leonardo da Vinci, the Anatomist (1452–1519). By J. PLAYFAIR MCMURRICH, Professor of Anatomy, University of Toronto. 7″ by 10″. Pp. 265 + xx, with 89 plates and illustrations. 1930. London: Baillière, Tindall & Cox. 27s. net.

WHEN reading this book one wonders how many of those drawn to the Exhibition of Italian Art of 1930, amid the dazzling delights and masterpieces, sought out the small, comparatively hidden, pen-and-ink sketches of Leonardo. All but one were anatomical, and yet, as one gloated over them, one felt sure that the majority of those obviously interested had no special knowledge of this science.

Professor McMurrich writes as an anatomist of an anatomist, and we have chapters which show the state of anatomical knowledge which served as a basis for Leonardo's work, how he worked, his anatomical manuscripts, and other matters connected with this particular aspect of so many-sided a character. Yet one cannot help thinking that the author was tempted to allot an undue space to the fascinating account of da Vinci's fortunes and his friends, in which we learn of his successive patrons, Sforza, Duke of Milan, Cæsar Borgia, and Charles d'Amboise: here we have the story, with a greater regard to historical accuracy, which forms so charming a basis of *The Forerunner* by Merejkowski.

The question naturally arises whether Leonardo, had he been less interested in other arts, would have been a greater painter. Without doubt his output which, compared with the colossal activities of some of his predecessors, was so small as to suggest indolence, would have been far greater had he given painting his undivided attention; yet it may be that a number of works of less merit would have less ably sustained his reputation than the few of which "The Adoration of the Magi" may be regarded as the type. As an anatomist he will be known to posterity as the discoverer of the moderator band in the heart; as an anatomical illustrator he was the first to depict what he actually saw in a dissected body. It is scarcely possible to realize how largely convention held the field in anatomical illustration up to his time, in spite of centuries of "Anatomies". Of course, as the author points out, Leonardo made mistakes, but there is nothing in the world of anatomical art to compare with the grace, poise, and accuracy of some of his sketches.

McMurrich shows how da Vinci's knowledge, based on Galenic tradition, was fostered by his master Verrochio, a name much spoken of now, when his equestrian statue of Bartholommeo Colleone is cited as an example for modern sculptors. While Leonardo escaped from the Arabian school of thought, he quotes Avicenna, and it is evident that, if we except Mondino, he had no guidance other than that

of the Arabian school to assist him in testing the accuracy of the conceptions of Galen. The author sums up his position in a single sentence, "Vesalius was undoubtedly the founder of modern anatomy. Leonardo was his forerunner, a St. John crying in the wilderness", and later he says, "If . . . the new movement in anatomy came from the artists, Leonardo may well be recognized as its originator and Vesalius as its great protagonist."

But just as when reading *The Forerunner* one was spirited away from consideration of the painter by the all-too-sketchy sidelights on Leonardo as an engineer, so here many will read with the greatest zest of him as trying out a flying machine which disappointed him sorely on many occasions; of his digressions into the fields of mechanics, dynamics, hydrostatics, and military and civil engineering; of how his work of erecting an equestrian statue of "Il Moro" was interrupted by the plague, and he did no more than produce the sketches, now one of the many treasures of Windsor Castle. In these varied capacities he came in contact with the most acute minds of his day, and it may be that to his association with Pacioli, who had become renowned by his work on the 'divine proportion', Leonardo owed the inspiration which led him to study the proportions of the human face and to reduce them to mathematical terms.

One cannot but be struck with the accuracy and agreement with modern presentation of both records and drawings, and when we compare the sketches with those which alone could serve as an example—those of Mondino's *Anathomia*—we cannot but be amazed at the extent to which Leonardo's art had advanced beyond that of his predecessors. Which brings one to the obvious inquiry: How, knowing so much and with such accurate powers of perception and illustration, did he miss the answer to the apparently simple question which obviously exercised a mind intrigued by the function of the bands traversing the ventricular cavities—a question only answered by William Harvey more than a hundred years after the death of da Vinci? In studying the circulation and the motion of the heart Leonardo allowed "theory to master observation"; that he studied its structure and the functions of its different parts very closely, and that the perfection of its mechanism excited his admiration, is evidenced by the words written under one of his illustrations of it—"wonderful instrument invented by the supreme master". Yet he accepted the Arabistic conception of three ventricles—the third being probably the left atrium; the right being regarded as part of the vena cava according to the description of Aristotle and Galen. Da Vinci drew and described the auricles, but spoke of them as ventricles. Failing to recognize the exact function of the pulmonary circulation, he accepted the Galenic hypothesis that the blood passed from the right to the left ventricle through minute pores.

The author goes on to review Leonardo's work and views upon the organs of respiration and of digestion and the nervous system, which show less inspiration than his original observations upon the heart and largely agree with the conceptions of Galen and others of his predecessors. Both in comparative anatomy and botany Leonardo's writings and drawings provide abundant evidence of his industry and powers of careful observation. In the former science he fell into the same mistake as Galen and the Salernitans in supposing that he could draw exact deductions from the anatomy of animals to that of men; much of his study was devoted to the wings of birds, on which he founded the structure of his flying machine. In botany Leonardo was a pioneer in the study of the laws of phyllotaxis (the arrangement of leaves); and to him also we owe the most interesting and far-reaching observation that the age of a tree may be determined by counting the growth-rings. All these aspects of Leonardo's activities are dealt with in a manner which will interest the amateur no less than the expert, and Professor MacMurrich concludes with an endeavour to assess his place amongst anatomists of the past. He writes that Leonardo had:—

> "The faith, the vigour, bold to dwell
> On doubts that drive the coward back,
> And keen through wordy snares to track
> Suggestion to its inmost cell."

Stepping Stones to Surgery (Anatomy Applied to Surgery). By L. BATHE RAWLING, M.B., B.Ch. (Cantab.), F.R.C.S., Surgeon to St. Bartholomew's Hospital. Demy 8vo. Pp. 228 + xvi, with 97 illustrations. 1930. London: H. K. Lewis & Co. Ltd. 12s. 6d. net.

EVEN if we cannot altogether subscribe to the accuracy of some of the observations made in this book or agree with the value and the lucidity of some of the figures, we must cordially recommend this volume in that it endeavours to encourage the study of anatomy on exactly the right lines—that is, as an adjunct to practical surgery. Thus, the author takes a case of acromegaly, and after setting forth the anatomy of the pituitary, describes the various pathological conditions which may result from diseases of that organ. This edition must, without doubt, be regarded as a venture which, if successful, is capable of considerable extension. The anatomy of the chief organs and structures of the body is illustrated by some thirty hypothetical cases, and it is to be hoped that in future editions their number will be added to with a discretion in selection equal to that of the present volume.

La Pratique chirurgicale illustrée. By VICTOR PAUCHET. Fasc. XV. Super royal 8vo. Pp. 245, with 200 illustrations drawn from nature by S. Dupret. 1930. Paris: G. Doin et Cie. Fr. 65.

THIS volume, like the preceding ones, covers a wide range of surgical subjects, all of which are fully and very ably illustrated by S. Dupret. Victor Pauchet is assisted by P. Moure on scalp grafts for replacement of eyebrows, and G. Liebault on frontal sinusitis. P. Mornard describes an interesting case of a large skin sarcoma on the inner surface of the arm. After excision this was replaced by an autoplastic graft of skin from the side of the chest wall. The same contributor shows the result of excision of the so-called 'abdominal apron' seen in very stout women. The umbilicus is transplanted into the upper flap and makes a perfect æsthetic result.

Victor Pauchet contributes a chapter on a diaphragmatic hernia, in a boy of 13, passing through the œsophageal opening. Subserous cholecystectomy is described in detail. The separation of peritoneum from the gall-bladder is aided by air or, better, oxygen. The fixation of a drainage tube into the fossa after the gall-bladder has been removed seems to detract rather from the value of this method of removal. Chapters on gastric ulcers, perforated gastric and duodenal ulcers, gastrojejunal anastomosis after gastrectomy, and precolic gastro-enterostomy with a long loop complicated by a jejunojejunal ulcer, give great scope to the artist.

What might be termed blind drainage of the pelvis from the right iliac fossa in cases of pelvic peritonitis due to appendicitis seems a useful method in extreme cases. For tumours of the sigmoid colon an ingenious and somewhat heroic operation is described and beautifully illustrated. It consists of excision of the tumour, followed by an anastomosis of the transverse colon to the lower sigmoid colon by the intervention of a loop of small intestine (from the illustration this must be a very high loop). A similar anastomosis has been described in a previous volume (Fasc. XIII).

Inguinal hernia with ectopic testis in an adult, and excision of a seminal vesicle together with a portion of prostate, approached by the perineal route, is taken step by step, and finally the epididymis and vas deferens on the affected side are removed in cases of tuberculosis. Lastly, seventeen pages of illustrations are given showing testicular grafts from monkeys to man by Mastigues, and removal of foreign bodies from the knee-joint by Mornard. At the end of the volume is given a complete index of all the chapters in previous volumes arranged according to the part of the anatomy dealt with. This makes the series of greater value and keeps up the high standard of the work.

Surgical Pathology and Morbid Anatomy (Bowlby and Andrewes). Revised by GEOFFREY KEYNES, M.A., M.D., F.R.C.S., Assistant Surgeon, St. Bartholomew's Hospital. Eighth edition. Medium 8vo. Pp. 644 + x, with 224 illustrations. 1930. London: J. & A. Churchill. 21s. net.

THIS book has been our friend from our youth up. There is still a real need for a work of this nature written by a surgeon with pathological leanings, but there are

now perhaps few surgeons who can write such a book single-handed. That he had not been able to keep himself abreast with the progress of pathology may be one of the reasons why Sir Anthony Bowlby called in Dr. Andrewes in the preparation of the fourth edition in 1919, and it is perhaps a pity that the new editor has not similarly taken a pathologist into collaboration, for this—the eighth edition—displays on every page the evils of the endeavour to put new wine into old bottles and yet to retain the flavour of the original vintage. Matters of great pathological and clinical interest at the present time are dismissed in a few lines, and space is wasted on subjects and discussions of little value. The basis of this volume is clinical pathology, and its value and teaching can be traced back from Bowlby to Paget and ultimately to John Hunter. This ideal and certain chapters on gas gangrene and shock are well worthy of preservation, and we cannot believe that it is impossible really to revise a work of this nature.

A Treatise on Orthopædic Surgery. By ROYAL WHITMAN, M.D., M.R.C.S., F.A.C.S., Consultant to the Hospital for the Ruptured and Crippled, to St. Giles' and St. John's Guild Hospitals, etc. Ninth edition, thoroughly revised. Large 8vo. Pp. 1085 + xii, with 981 engravings. 1930. London: Henry Kimpton. 45s. net.

THIS very popular and useful text-book continues to appear in a new edition every two to three years. With each edition the book grows to a slight extent, and the present volume is no exception in this respect. From the point of view of its usefulness as a text-book, this continued increase in size is becoming a definite defect. There is now much obsolete material included—for example, no fewer than thirteen pages, with a large number of illustrations, are devoted to Abbott's method of correcting scoliosis in plaster; the account concludes with the statement that at the Hospital for the Ruptured and Crippled, the Abbott method has been discontinued in favour of correction in the upright posture. In fact, the method has been discontinued at almost every orthopædic clinic in which it has been used. Another example is the description of many methods of splinting hip disease, including all sorts of ambulatory splints which are not really in use. There is also, perhaps, a tendency to include lengthy and well-illustrated descriptions of new operations some of which are still in their trial stage, such as some of the more elaborate operations for transplanting muscles and tendons in old-standing cases of poliomyelitis. These procedures have a very limited utility, because they apply only to cases with a certain definite distribution of the paralysis. On the other hand, there are some items which would deserve greater attention. The short description of internal derangement of the knee-joint is quite inadequate by English standards, because this injury is so extremely common in all our English bone and joint clinics. Renal rickets is dismissed in three lines, and the section on late rickets is also very sketchy.

These criticisms are not intended to suggest that the book does not deserve its popularity. It still remains one of the best of orthopædic text-books, but it would benefit by a very thorough and drastic revision which aimed at a considerable reduction in its bulk.

Illustrated Primer on Fractures. Prepared by the Co-operative Committee on Fractures. Under the auspices of the Section on Surgery, General and Abdominal, and the Section on Orthopedic Surgery, in co-operation with the Department of Scientific Exhibit, of the American Medical Association. Demy 4to. Pp. 55, with 18 illustrations. 1930. Chicago: American Medical Association. $1.00.

THIS is a book about which there will probably be two diametrically opposite views. It represents in some fifty pages a series of charts demonstrating methods of treatment of common types of fractures, with legends which, in typically trans-Atlantic language, tersely stress the chief points to be observed in carrying out treatment which is likely to meet with success. Whether such a volume is appreciated or decried, it must be admitted that the demands for its publication by a large number of the members of the American Medical Association indicates an appreciation of the medico-legal aspect of fractures and an interest in their treatment which, in the

judgement of some teachers, might with advantage be wafted over the Atlantic. The legends which adorn the pictures are much to the point. Whether there is a demand for a volume of this type in this country, and whether such a publication would produce any adequate financial return, is perhaps doubtful.

Clinique et Therapeutique chirurgicales. By GEORGE PASCALIS. Pratique Journalière. Medium 8vo. Pp. 290, with 80 illustrations. 1930. Paris: Gaston Doin et Cie. Fr. 50.

THE author points out in his preface that his aim is to classify the descriptions of certain symptoms occurring in a variety of surgical conditions which appear complicated to the beginner. One feels he has succeeded admirably. In this publication of 290 pages there are 80 illustrations, for which Mr. Wagner has due acknowledgement. The subjects dealt with cover a very wide field; the domains of the orthopædic surgeon, the dental surgeon, the general surgeon, and the gynæcologist are invaded.

In ruptured tendons the use of silk (No. 0) soaked in sterile vaseline is advocated, and when a graft is necessary dog's tendon preserved in alcohol. This type of heterogenous graft is also referred to in the repair of cruciate and lateral ligaments of the knee-joint. The author's abduction splint in the treatment of fracture of the upper end of the humerus is well illustrated. The chapter on old dislocations of the shoulder, after dealing with signs and symptoms, describes an operation for exposure of the joint and replacement of the head of the humerus. No way of preventing recurrent dislocations is given. Ankylosis of the hip-joint, sprains and tuberculosis of the knee-joint, and fractures of the ankle-joint, with treatment, are dealt with. Buerger's disease is gone into fully and an extremely good description of the condition is given. In the treatment of the disease peri-arterial sympathectomy gives only a temporarily good effect, and suprarenalectomy is suggested. In the chapter on acute appendicitis early operation is advocated and retrograde removal is illustrated.

In discussing the treatment of ulcers on the lesser curvature of the stomach, if medical treatment fails, local excision, or partial gastrectomy—Billroth II method—is practised. Transgastric excision is carried out in the case of the high ulcer on the posterior surface. In strangulated femoral hernia the use of local anæsthesia and division of Poupart's ligament is mentioned. Chapters are devoted to strictures of the small intestine, penetrating wounds of the abdomen, also the diagnosis and treatment of carcinoma of the rectum. With regard to the latter, 60 per cent of the cases seen are inoperable. Radium treatment is only just mentioned, and the author refers to one case in which there was an unexpected result.

In the treatment of ascites a method of injecting 6 litres of sterile water at 45° C. into the peritoneal cavity, with subsequent withdrawal half an hour later, has met with the best results. For the gynæcologist there are chapters on retroversion of the uterus, uterine fibroids, and ovarian cysts.

A good description of calculous cholecystitis is given. Cholecystectomy is the operation of choice and a subserous dissection made whenever possible. The last chapters deal with hydatid disease of the liver, anthrax, pleural fistulæ, and the treatment of fibro-adenomata of the prostate. In the latter condition the author is against the use of gauze drainage as it tends to infection and secondary hæmorrhage. He advocates Marion's suprapubic drainage tube.

The publication is a very stimulating one (of interest to the surgeon as well as the student), covering a wide range of surgical subjects, and the facts are based on the author's practical experience.

Collected Papers of the Mayo Clinic and the Mayo Foundation. Edited by Mrs. M. H. MELLISH, RICHARD M. HEWITT, M.A., M.D., and MILDRED A. FELKER, B.S. Vol. XXI. 1929. Medium 8vo. Pp. 1197 + xxiii, with 276 illustrations. 1930. Philadelphia and London: W. B. Saunders Co. 60s. net.

EACH time one opens a new volume of these papers, one is staggered by the continued expansion of the personnel of the Mayo Clinic and Foundation, and in like

proportion the output of publications from the Clinic increases. Thus in this volume of 471 papers at the disposal of the editors, 90 only are reprinted in full, 91 are abridged or abstracted, and 290 are mentioned only by title. Balfour contributes a very helpful paper on the operative treatment of ulcers of the posterior wall of the duodenum, but it is perhaps a pity that with the large amount of material at his disposal he should not have supplied some statistical support to his statement of the frequency of these lesions.

W. J. Mayo's paper on diverticulitis read before the British Medical Association at Manchester in July, 1929, presents a clear picture of the various clinical types of the disease, and the writer carries one into the medicine of the future with his interesting suggestions of the relationship of the sympathetic nervous system to the formation of acquired diverticula. In Snell's paper on recent advances in endocrinology there is much which surgeons interested in metabolism must learn to appreciate the value of and to apply. This paper contains an interesting account of hyperparathyroidism and discusses the use of parathormone. It would be well if those addicted to the universal administration of endocrine extracts would realize the warning contained in this paper with regard to the influence for harm which such substances are capable of producing when indiscriminately used.

There is only a short abstract of Waltman Walters' paper on pulmonary embolism: he shows that by the use of a regimen of which the most important feature is administration of thyroid extract—2 gr. three times a day—the incidence of embolism has during the last four and a half years been reduced to one quarter. This is a paper which every surgeon should read in full. Two papers by Lundy contrast the anæsthetic requirements for operations on the upper and those on the lower abdomen. He suggests that posterior splanchnic block has not a wide application, and makes helpful suggestions for the use of spinal anæsthesia for upper abdominal operations, though he points out that this method has its greatest field of usefulness on operations of the lower abdomen. MacCarty again urges the diagnostic value of frozen sections. It is difficult to understand why this method has not been at least accorded a trial by some of the pathologists in this country. If after a short experience such informative frozen sections can be obtained for the surgeon's guidance during the operation as those which are shown in this paper, it is surely desirable that every pathologist should have the working principles of the method at his disposal.

St. Bartholomew's Hospital Reports. Edited by Sir THOMAS HORDER, Bart., K.C.V.O., RONALD G. CANTI, WILFRED SHAW, W. LANGDON BROWN, W. GIRLING BALL, and GEOFFREY EVANS. Vol. LXIII. Demy 8vo. Pp. 277 + xxvi. Illustrated. 1930. London: John Murray. To subscribers, 15s.; to non-subscribers, £1 1s.

To write well of the life of an old master, the pupil must be in complete accord with his subject. It must be admitted that in his review of the life of Sir Anthony Bowlby, Mr. Girling Ball was fortunate in his subject; but that he fulfils his purpose well is in great part due to the fact that his task was evidently congenial. His affection and admiration for his teacher are obvious from the first page, and yet they do not obscure his judgement when he attempts to assess his position as a surgeon and to evaluate him as a man.

Bowlby's value to his hospital and medical school was considerable, but the Great War offered him an opportunity of which perhaps he was able to take greater advantage than any other living surgeon would have been, not only in co-ordinating the Medical Department with the needs of the combatant authorities, but also in conciliating the former to the demands of the doctors in their interest for the sick and wounded. It must be also borne in mind that the tact which Bowlby exercised was one of the chief factors which allowed a regular R.A.M.C. officer to find himself often in a subordinate position to a civilian with temporary rank. For the display of such qualities under all circumstances of threatening defeat and success Bowlby earned the thanks, not only of his profession, but of the whole nation. It is characteristic of the race that a very inadequate appreciation of the services he

rendered was granted to him in his lifetime when we compare it with the honours and gratuities bestowed upon members of the fighting forces for what was certainly a much less successful record in positions of vastly less difficulty.

Mr. T. A. Lodge provides an interesting record of the new surgical block which, though written by an architect, will be easily comprehended and of great interest to any surgeon who is taking a share in a similar enterprise.

Dr. Dicks discusses the clinical value of Lyon's method of transduodenal biliary drainage. Mr. Raven contributes a careful analysis of eighty cases of perforated duodenal and gastric ulcers, and Mr. Corbett endeavours to assess the period of disability in ambulatory fractures from a review of some 250 cases treated in the Fracture Clinic.

The Dawn and Epic of Neurology and Surgery. By Sir CHARLES BALLANCE, K.C.M.G., C.B., LL.D., F.R.C.S. 8vo. Pp. 40. Illustrated. 1930. Glasgow: Jackson Wylie & Co.

SIR CHARLES BALLANCE, in this the Macewen Memorial Lecture for 1930, traces neurology from the time of prehistoric trephining to the present day, when it has culminated in the work of Dr. Harvey Cushing of Boston, Massachusetts, and of Sir Percy Sargent in London. Surgical neurology—if such a term is permissible—was empirical and rarely practised until Ferrier, Victor Horsley, Sir William Macewen, and Ballance himself, to speak only of the pioneers in Great Britain, based it on experiment and thus made it scientific. The thesis sustained is that operative neurology needs the devotion of a lifetime and should only be undertaken by those who are specially drawn to the subject. The lecture is illustrated with portraits of Macewen, Pasteur, Lister, Hughlings Jackson, David Ferrier, John Hunter, and Harvey Cushing. It is published as No. XVI of the Glasgow University Publications, and well repays perusal.

Shorter Convalescence. By Lieut.-Colonel JAMES K. MCCONNEL, D.S.O., M.C., Member of the Chartered Society of Massage and Medical Gymnastics; Bio-physical Assistant (working at St. Thomas's Hospital). With a Foreword by Sir ROBERT JONES, Bart., K.B.E., C.B., F.R.C.S. Crown 8vo. Pp. 132 + xi. Illustrated. 1930. London: William Heinemann (Medical Books) Ltd. 5s. net.

COLONEL MCCONNEL has written a little volume which will well repay study by the operating surgeon, particularly the surgeon who carries out many routine abdominal operations. The idea is to suggest methods whereby the period of flabbiness following an illness or an operation may be curtailed. He points out the common but erroneous idea that exercises necessarily involve extensive movements with considerable muscular effort. What is needed in convalescence is, rather, small exercises introducing co-ordination and control of muscular activity. Such exercises can be quite well given in bed, and the automatic co-ordination of movements involved in standing and walking can be taught before the patient gets up.

The book is small, but not easily read; although the descriptions are somewhat involved, they are so arranged as to add interest to the subject, and the surgical reader should not be put off if he finds a little difficulty in following the author's ideas.

Surgery of the Lung and Pleura. By H. MORRISTON DAVIES, M.A., M.D., M.Ch. (Cantab.), F.R.C.S., Medical Superintendent, Vale of Clwyd Sanatorium, etc. Demy 8vo. Pp. 355 + xvi, with 104 illustrations. 1930. London: Oxford University Press. 28s. net.

THIS book on intrathoracic surgery is based upon a former volume by the same author published in 1919, but, as the author states in the preface, owing to the enormous advance in intrathoracic surgery, apart from the chapter on anatomy, which has been revised, the whole book has been rewritten and the greater number of the illustrations are new.

The chapter upon physiological considerations largely embodies the researches and supports the conclusions of Graham, whose work has revolutionized the treatment

of certain types of purulent pleural effusions. The section upon the treatment of chronic empyema, a most difficult condition to cure, is somewhat disappointing, as one would have expected the author to have given more definite indications for the different operations which are mentioned in the text. The chapter on pulmonary tuberculosis, which includes a section upon treatment by artificial pneumothorax, is full of information, and can be recommended as a non-controversial account of the present position of surgery in this disease. The succeeding review of phrenic evulsion, thoracoplasty, and extrapleural pneumolysis contains an account of the comparative value of artificial pneumothorax and thoracoplasty. Each can be shown to have certain advantages. In the operation itself the author recommends the use of chloroform combined with local novocain as the means of anæsthesia, and makes the statement that "the after-condition is also more satisfactory than that following gas and oxygen", a statement which is open to considerable doubt.

Bronchiectasis and pulmonary abscess are dealt with upon accepted lines, but the value of the administration of arsenical compounds, especially in the latter condition, would appear worthy of mention. There is an excellent chapter on hydatid cysts, but that on primary tumours of the lung and mediastinal dermoids is short and contains very little of the recent work on diagnosis and treatment of these conditions.

The small amount of criticism necessary shows that the book is fully representative of the generally accepted teaching of the surgery of the lung and pleura at the present day, and can be thoroughly recommended.

Cancer of the Lung and other Intrathoracic Tumours. By MAURICE DAVIDSON, M.A., M.D., B.Ch. (Oxon.), F.R.C.P. (Lond.), Physician to the Brompton Hospital for Diseases of the Chest, etc. With a Foreword by ARTHUR J. HALL, M.A., M.D., D.Sc., F.R.C.P. (Lond.), Professor of Medicine, University of Sheffield. Super royal 8vo. Pp. 173 + x, with 62 illustrations. 1930. Bristol: John Wright & Sons Ltd. 17s. 6d. net.

THE increasing interest and the numerous papers in the medical press on malignant disease in the chest have long necessitated the production of a monograph upon this important subject. This want has been filled by the volume under review. The book contains chapters upon the history and statistical aspects, morbid anatomy and histology, etiology, clinical and radiological aspects, diagnosis, and treatment. It has, in addition, a chapter upon non-malignant intrathoracic tumours.

From the figures quoted it would appear that there has been a definite absolute increase in the incidence of malignant disease of the lung during the last twenty years, but although various predisposing factors such as influenza, tobacco, war gas, petrol fumes, and road tar have been held to account for the increase, no observations have been made so far which would justify conclusions on this point. The association between tuberculosis and cancer is pointed out as incidental rather than one of cause and effect, a view which would appear to be confirmed by the statistics of the autopsies at Brompton Hospital, in which only 6·5 per cent of the cancer cases had definite associated tuberculous disease. The clinical section is made more interesting by the inclusion of the notes of a series of twenty-two cases.

The greater portion of the recent improvement in the diagnosis of intrathoracic disease is due to the radiologist, and this aspect is fully discussed, and well illustrated by some excellent reproductions of skiagrams of pulmonary growths of various types.

The chapter on treatment is of considerable interest, as it indicates the view of the more progressive physicians towards surgical measures in the chest. The author states that the "advance in our operative technique in the last few years has been such that it can now be said with truth that in expert hands the operative risks of intrathoracic surgery are no greater than those of abdominal surgery, and that manipulations within the chest carry with them no more anxiety than any recognized major operation within the peritoneal cavity; in some cases it may be said to be less."

This volume can be recommended to all those interested in chest disease as an excellent short review of the present position of our knowledge in regard to malignant disease in the chest.

Die Knochenbrüche und ihre Behandlung. Ein Lehrbuch für Studierende und Ärzte. By Prof. Dr. HERMANN MATTI (Bern). Second edition. Royal 8vo. Pp. 938 + xvi, with 1000 illustrations. 1931. Berlin: Julius Springer. Paper covers, RM. 86; bound, RM. 89.60.

THIS is a very full and complete account of the subject of fractures and their treatment by one of the Berne school, who has dedicated his work to Kocher. The great size of the work is accounted for by the fact that it includes the subjects of cerebral and spinal complications of the fractures of the skull and vertebral column; and also by the lavish wealth of the illustrations.

The first part (237 pp.) is occupied by a discussion of general principles, anatomy, pathology, and treatment, and is on the whole well balanced and inclusive, although the sections on operative methods are much less complete than those on traction methods of treatment. The second part (167 pp.) is concerned with fractures of the skull and their cerebral complications. The different phases of cerebral symptoms are described and discussed with great care and detail, and both diagnosis and treatment are fully dealt with. This section includes a good account of gunshot injuries of the skull and brain.

The next section (63 pp.) deals with fractures of the spine, and, like all other parts of the work, is very copiously illustrated. The different types of lesion and the symptoms produced are very fully given, but the latent type of disease described by Kümmell does not seem to have a distinct enough recognition, and the section on treatment is disappointing as giving so scanty a reference to methods and indications for operative fixation.

The remainder of the volume gives a systematic description of fractures of individual bones, and in its wealth of illustration affords a most useful book of teaching and reference. As an exposition of modern traction methods of treatment this book is very complete and convincing, but as a comprehensive account of modern fracture treatment, and especially from the point of view of open operations, it is distinctly disappointing. The great charm and value of the book is the number of illustrations and the beautiful way in which they are reproduced.

La Pratique du Pneumothorax thérapeutique et de la Collapsothérapie chirurgicale. By F. DUMAREST and P. BRETTE. Medium 8vo. Pp. 409 + xiii. Illustrated. 1929. Paris: Masson et Cie. Fr. 50.

THIS volume is an enlarged revision, with the addition of a chapter on surgical collapse, of two previous editions of *La Pratique du Pneumothorax thérapeutique*. An unnecessarily long account is given of various forms of apparatus, needles, etc., for the production of pneumothorax. The authors regard pleural shock as a generic term for the two conditions of pleural reflex and gas embolism. Its avoidance can be largely ensured by careful attention to operative details, although the value of adequate local anæsthesia does not appear to be sufficiently stressed in this connection. The further treatment of pulmonary tuberculosis by artificial pneumothorax is fully discussed, and the value of the treatment is considered to be due to its allowing spontaneous contraction of the lung rather than to active compression.

The pleural group of complications are common, and the figures quoted show that the frequency of pleural effusions of all types varies with the different authors quoted, from 52 per cent (Rist and Naveau) to 100 per cent (Matson, Matson and Bisaillon). Unquestionably the routine use of screen examination at frequent intervals in all cases accounts for the high figures of the latter authorities, evanescent effusions, of no moment in many cases, being included. The more striking figures are those of Dumarest, in which between 16 and 18 per cent of purulent effusions supervene. As one would expect under these circumstances, the treatment of these effusions is fully described.

Oleothorax is advised in contracting pneumothorax, for the obliteration of pleuropulmonary fistula, and in certain cases of purulent pleural effusions, either simple or secondarily infected, all conditions which are otherwise often difficult to control, but the value of oleothorax in all except contracting pneumothorax is debatable.

A short chapter is devoted to thoracoscopy and the cauterization of adhesions, but owing to the inexperience of the authors with the method of treatment, it is neither recommended nor condemned. The concluding chapter on surgical collapse contains a description of the operations of phrenicotomy and thoracoplasty, with their indications, complications, and results.

This book, taken as a whole, can be relied upon as an adequate presentation of treatment by artificial pneumothorax, although that portion devoted to surgical collapse falls somewhat below the general standard of the remainder of the volume.

BOOK NOTICES.

[*The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest for our readers.*]

Souvenir—Cinchona Tercentenary Celebration and Exhibition at the Wellcome Historical Medical Museum. By HENRY S. WELLCOME, LL.D., F.S.A., and L. W. G. MALCOLM, M.Sc. (Cantab.), F.R.S.E. $9\frac{3}{4}'' \times 6\frac{3}{4}''$ Pp. 115. Illustrated. 1930. London: The Wellcome Foundation Ltd.

William Stewart Halsted: Surgeon. By W. G. MACCALLUM. Introduction by Dr. W. H. WELCH. Large post 8vo. Pp. 241 + xvii. Illustrated. 1930. Baltimore: The Johns Hopkins Press. London: Oxford University Press. 12s. 6d. net.

Radium Therapy: Principles and Practice. By G. E. BIRKETT, *M.C.*, B.A. (Cantab.), M.R.C.S., Hon. Radiologist, Manchester and District Radium Institute and Christie Hospital for Cancer. Royal 8vo. Pp. 186 + x, with 6 colour and 13 half-tone plates and 52 illustrations in the text. 1931. London: Cassell & Co. Ltd. 17s. 6d. net.

Pye's Surgical Handicraft. Edited by H. W. CARSON, F.R.C.S., Late Senior Surgeon, Prince of Wales's General Hospital, Tottenham; Lecturer on Abdominal Surgery, North-east London Post-graduate College. Tenth edition, fully revised. Medium 8vo. Pp. 641 + xviii, with 22 plates and 343 illustrations in the text. 1931. Bristol: John Wright & Sons Ltd. 21s. net.

Sir D'Arcy Power: Selected Writings, 1877–1930. Medium 8vo. Pp. 368 + x. Illustrated. 1931. Oxford: The Clarendon Press. 25s. net.

Cancer and Scientific Research. By BARBARA HOLMES, Ph.D. (Cantab.), Biochemical Laboratory, Cambridge. With a Preface by Professor Sir F. G. HOPKINS, President of the Royal Society. Crown 8vo. Pp. 160. 1931. London: The Sheldon Press. 3s. 6d. net.

Guy's Hospital Reports. Edited by ARTHUR F. HURST, M.D. Vol. LXXX (Vol. X. Fourth Series). October, 1930. Royal 8vo. Pp. 379–500. Illustrated. 1930, London: The Lancet Ltd. Single numbers, 12s. 6d. net; annual subscription, £2 2s. net.

Spezielle chirurgische Diagnostik für Studierende und Ärzte. By Dr. F. DE QUERVAIN (Bern). Ninth edition, fully revised. Super royal 8vo. Pp. 916 + xvi, with 833 illustrations in the text and 6 plates. 1931. Leipzig: F. C. W. Vogel. Paper covers, RM. 75; bound, RM. 78.60.

Die äusseren Abdominal-Hernien. By Dr. ERICH BUMM, Assistent an der Chirurgischen Universitätsklinik, Berlin. Imperial 8vo. Pp. 331 + viii, with 235 illustrations. 1931. Berlin and Vienna: Urban & Schwarzenberg. Paper covers, RM. 40; bound, RM. 42.50.

Modern Surgery: General and Operative. By JOHN CHALMERS DA COSTA, M.A., LL.D., F.A.C.S., SAMUEL D. GROSS, Professor of Surgery, Jefferson Medical College, Philadelphia, etc., assisted by BENJAMIN LIPSHUTZ, M.D., F.A.C.S., Surgeon to the Mt. Sinai Hospital, Associate in Neuro-anatomy, Jefferson Medical College, etc. Tenth edition, revised and reset. Royal 8vo. Pp. 1404, with 1050 illustrations. 1931. Philadelphia and London: W. B. Saunders Co. 45s. net.

Diseases of the Tongue. By WALTER G. SPENCER, M.S., F.R.C.S., Consulting Surgeon, Westminster Hospital; and STANFORD CADE, F.R.C.S., Assistant Surgeon, Westminster Hospital. Being the third edition of Butlin's *Diseases of the Tongue*. Demy 8vo. Pp. 561 + xvi, with 123 illustrations in the text and 20 coloured plates. 1931. London: H. K. Lewis & Co. Ltd. 35s. net.

Clinical Examination and Surgical Diagnosis. By FÉLIX LEJARS, Professeur de Clinique chirurgicale à la Faculté de Médecine de Paris. Translated by HELEN C. SCOTT, M.R.C.S., L.R.C.P. Large 8vo. Pp. 872 + xi, with 1094 illustrations. 1931. London: Johnathan Cape Ltd. 50s. net.

Die Chirurgie des vegetativen Nervensystems. By ERICH HESSE (Leningrad). Large 8vo. Pp. 475, with 133 illustrations in the text and 14 coloured plates. 1930. Moscow and Leningrad: Staatsverlag.

Annals of Roentgenology: a Series of Monographic Atlases. Edited by JAMES T. CASE, M.D., Professor of Roentgenology, Northwestern University Medical College. Chicago. Volume XII. The Chest in Children. By E. GORDON STOLOFF, M.D. Crown 4to. Pp. 432 + xxx, with 401 illustrations. 1931. New York: Paul B. Hoeber Inc. $15.00.

Clio Medica Series. A series of Primers in the History of Medicine. Editor: E. B. KRUMBHAAR, M.D. F'cap 8vo. 1930 and 1931. New York: Paul B. Hoeber Inc. $1.50 per volume.

The Beginnings: Egypt and Syria. By WARREN R. DAWSON, F.R.S.E., Fellow of the Royal Society of Medicine, etc. Pp. 86 + x.

Medicine in the British Isles. By SIR D'ARCY POWER, K.B.E., F.R.C.S., Hon. Librarian at the Royal College of Surgeons of England, etc. Pp. 84 + x. Illustrated.

Anatomy. By GEORGE W. CORNER, M.D., Professor of Anatomy in the University of Rochester. Pp. 82 + xvii. Illustrated.

Internal Medicine. By Sir HUMPHRY ROLLESTON, Bart., G.C.V.O., K.C.B., M.D., Hon. D.Sc., D.C.L., LL.D., Regius Professor of Physic in the University of Cambridge. Pp. 92 + x.

Physiology. By JOHN F. FULTON, M.D., Stirling Professor of Physiology, Yale University. Pp. 141 + xvi. Illustrated.

Chirurgie esthétique pure (Technique et Résultats). By RAYMOND PASSOT, Ancien Interne des Hôpitaux de Paris. Collection des Actualités de Médecine pratique edited by Dr. R. J. WIESSENBACH, Médecin des Hôpitaux de Paris. Crown 8vo. Pp. 283 + xx, with 80 illustrations in the text and 8 plates. 1931. Paris: G. Doin et Cie. Fr. 45.

Cancer and Race: a Study of the Incidence of Cancer among Jews. By MAURICE SORSBY, M.D., F.R.C.S.E., Hon. Assistant Surgeon, Ear, Nose, and Throat Department, London Jewish Hospital, etc. With a Preface by Lieut.-Col. F. E. FREMANTLE, M.A., M.D., M.Ch., F.R.C.P., F.R.C.S., D.P.H., M.P., Consulting County Medical Officer of Health for Herts. Conducted under the auspices of the Jewish Health Organization of Great Britain. Demy 8vo. Pp. 120 + xvi. 1931. London: John Bale, Sons & Danielsson, Ltd. 7s. 6d. net.

Fractures and their Complications. By GEORGE EWART WILSON, M.B. (Tor.), F.R.C.S., F.A.C.S., Surgeon-in-Chief, St. Michael's Hospital, Toronto, etc. Medium 8vo. Pp. 415 + viii, with 306 illustrations. 1931. London: Ballière, Tindall & Cox. 35s. net.

Chirurgische Krankengymnastik. By Dr. KARL GEBHARDT, Assistant der Chirurgischen Universitäts-Klinik, München (Geheimrat Lexer), und Oberarzt der Sportabteilung. Imperial 8vo. Pp. 46, with 37 illustrations. 1931. Leipzig: Johann Ambrosius Barth. RM. 3.8.

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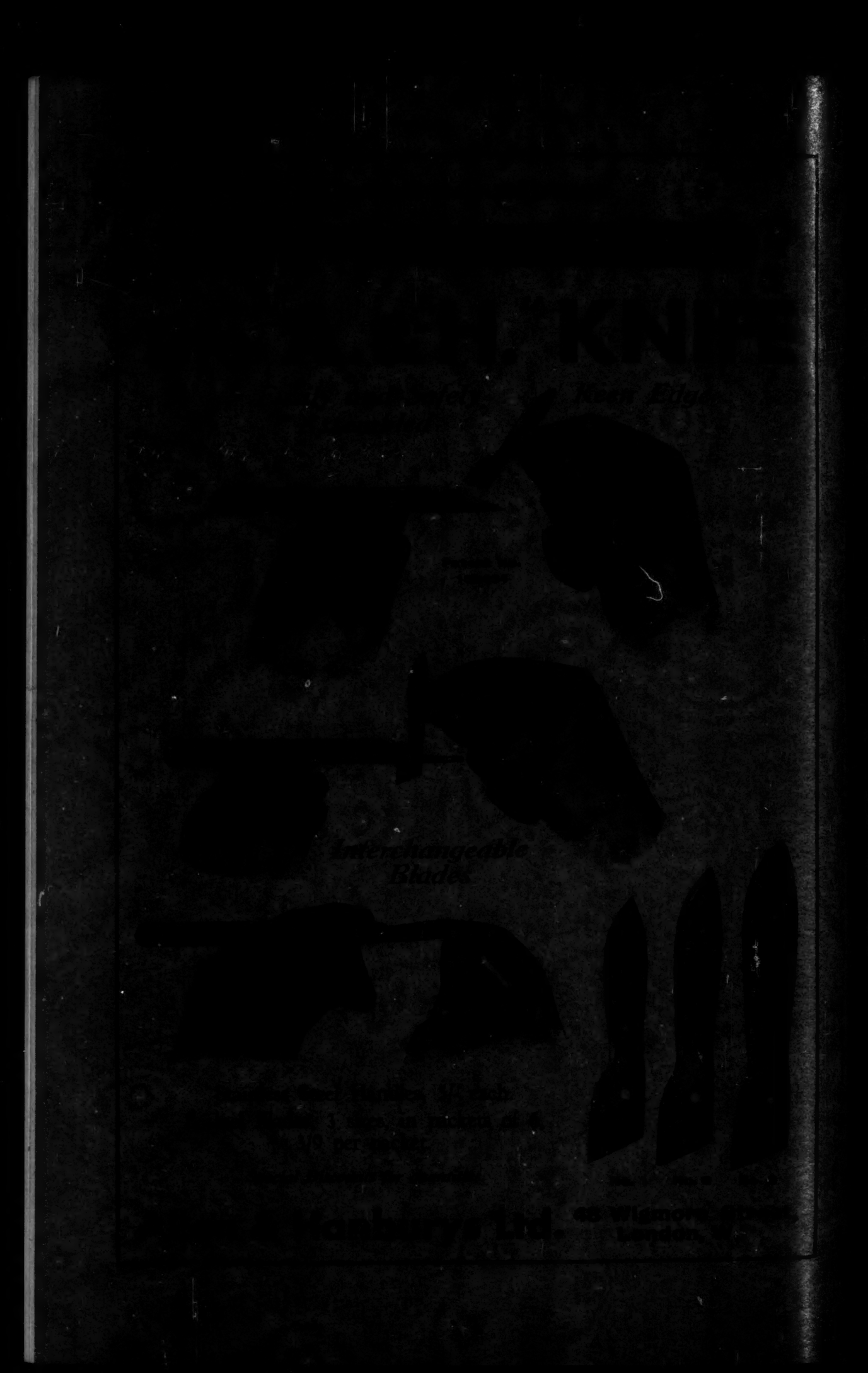
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